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FOREWORD

This report consists mainly of unpublished material and is intended for in-service use only.

The studies from which these facts were obtained are conducted in cooperation with State Agricultural Experiment Stations.

Comments on the simplified format of this report would be appreciated. All suggestions are welcomed.

CONTENTS

New York

FERTILITY IMPORTANCE SHOWN BY PASTURE IRRIGATION STUDY

G. R. Free, E. A. Engdahl, J. L. McGuiness, Ithaca. --Dry matter production of ladino-orchard grass pasture mixture was not increased by irrigation when a heavy rate of fertilization was used in a four year study in New York. Irrigation did increase yields at a normal rate of fertilization (300 pounds of 0-20-20 each spring) but the yield produced was no greater than that secured by heavy fertilization without irrigation. However, the ladino clover disappeared under the high rate of fertilization. The high rate of fertilization consisted of 1,500 pounds 0-20-20 per acre each spring plus nitrogen at 40 pounds per acre each spring and after each cutting.

The study was conducted at the Arnot station near Ithaca, at an elevation of nearly 1,900 feet. The soil is Mardin silt loam, moderately well drained and acid, with a compact mottled horizon below the 18-20" depth. Land capability class is III.

The study ran from 1949 through 1953. Lime and manure were applied as uniform treatments. Forage harvest was by frequent clippings to simulate rotational grazing. May-October rainfall during the four years ranged from 15.6" to 19.5" compared to a 19-year mean of 19.8". Mean temperatures for July and August at the Arnot station are 68° and 67°, respectively. Irrigation was applied to maintain available soil moisture above 50%. Amounts of irrigation water used per year during the study ranged from 5-1/2 to 10-1/2 inches.

Forage production at the high fertility rate was about four tons per acre whether irrigated or not. Only in 1952, the lowest rainfall year, did production on normal fertilized and irrigated plots exceed that on high fertilized, non-irrigated. Average rainfall for one four-week period that summer was only 0.03 inches; such a low is expected only once in 20 years. In 1952 there was a 1.1 ton per acre increase from irrigation of normal fertility plots and 0.6 tons per acre increase from irrigation of the high fertility plots.

Average annual yields on a dry matter basis for the four-year period were as follows:

	Rain Only (t/a)	Rain & Irrigation (t/a)
Normal Fertility	1.85	2.36
High Fertility	3.92	4.02

Omitting the first cutting each year, which represents an uncertain period of growth, average daily yields of dry forage were 29 and 54 pounds per acre, respectively, under normal and high fertility treatments. Mean air temperature for a cutting period was significantly correlated with yields at normal fertility level but not at high fertility. Correlation between average daily rainfall during the four week period preceeding cutting and yield was highly significant. The effect of water on yield was slight as long as average daily amount was 0.11 inches or more.

The cumulative beneficial effect of the fertility treatments was illustrated by first cutting yields on May 26, 1954 of 1.64 and 1.20 tons per acre for plots receiving high and normal treatments, respectively, from 1950 to 1953. The yield for the untreated area surrounding the plots was only 0.35 tons per acre.

It was concluded that the first and foremost need for high level production of pasture forage on this soil and site was improvement of the fertility level. With this provided, supplemental water produced little additional dry matter. Irrigation at the normal fertility level did, however, give high production and allow retention of the legume in the mixture.

Puerto Rico

HIGH YIELDS OF THREE CROPS DECREASE WATER REQUIREMENTS PER UNIT

J. Vicenti' Chandler, Rio Piedras.--Water requirements per unit of dry matter produced were found to decrease as yields of sugar cane, bananas, and guineagrass increased in a four year study in Puerto Rico. Four irrigation treatments were used for sugar cane, water being applied whenever soil moisture tension reached 1/3, 2, 6, or 12 atmospheres. Three moisture levels--1/2, 2, and 12 atmospheres maximum tension --were used for bananas. Two nitrogen fertilization treatments but no moisture variables were used for guineagrass, and cotton was grown for comparative purposes with a high rate of fertilization and frequent irrigation. Climatic conditions varied relatively little during this study, 1950-1954. Relative humidity average 80%, solar radiation 420 gram calories per square centimeter daily, mean monthly temperature 78°F, daily wind movement 50.4 miles, open pan evaporation 0.23 inch daily and evaporation from a bare soil with normal irrigation .06 inch daily. There was no clear relationship between open pan evaporation, which is a measure of the cumulative effects of all climatic factors affecting evaporation, and water use by the crops.

The accompanying table gives a brief summary of the results. Even though the amount of water used increased with increasing yields, less water was needed to produce a unit of dry matter at higher yield levels. This was true whether the increased yield was the result of increased irrigation or increased fertilization. The average number of pounds of water per pound of dry matter produced was 700 for sugar cane, guineagrass and bananas and 1,250 for cotton.

Stage of growth was found to influence water use rate in this study. When the crop was starting to grow, water use was low and the use rate increased with age to maturity.

This study indicates that where climatic variations are not great, moisture use is affected to a relatively great extent by crop management practices. Crops can use moisture with maximum efficiency only when they are adequately fertilized and supplied with adequate moisture.

Consumptive use of water and yields of sugar cane, guineagrass, cotton, and bananas under various treatments, Puerto Rico 1950-54

Crop	Treatment	Average daily moisture use	Yield per acre[1]
Sugar cane....	Irrigation:		
	Wet	.036	93 tons
	Medium	0.27	62 tons
	Med. dry	0.21	50 tons
	Dry	0.19	33 tons
Bananas.....	Irrigation:		
	Wet	0.16	52,400 pounds
	Medium	0.11	39,300 pounds
	Dry	0.04	4,000 pounds
Guineagrass...	Nitrogen fertilizer[2]	0.18	18,010 pounds
	No fertilizer	0.16	8,870 pounds
Cotton.....	Fertilization and irrigation[3]	0.33	4,700 pounds

[1] In terms of green cane, green fruit of bananas, dry matter content of guineagrass, and seed cotton.
[2] 300 pounds N per acre.
[3] High rate of fertilization, frequent irrigations.

Missouri

USE OF WATER BY CORN FROM RESERVE IN CLAYPAN SOIL IS MEASURED

D. M. Whitt, Columbia.--Low rainfall in the summer of 1954 permitted measurement of water used by corn from the soil reserve on Mexico silt loam, a heavy claypan soil in central Missouri. All plots were fertilized with lime, phosphate and potash according to soil tests, and half the plots received 125 pounds of nitrogen per acre while the other half received 245 pounds. Two irrigation treatments were employed: W_2 received an application whenever the soil moisture deficit reached two inches during the period from planting until eight weeks after tasseling; W_3 was irrigated whenever deficit reached three inches during the same period. Rainfall, mean daily maximum temperatures, and consumptive water use by corn by periods are summarized below:

Rainfall, irrigation, temperature and water use by corn, McCredie Farm, Missouri, 1954

Period	Rainfall	Irrigation		Mean daily max. Temp.(F)	Mean daily water use		
					Unirrigated	Irrigated	
		W_2	W_3		W_1	W_2	W_3
	Inches	*Inches*	*Inches*	*Degrees*	*Inches*	*Inches*	*Inches*
6/11-7/9...	1.18	2.83	3.55	94	.18	.20	.17
7/9-7/21...	.07	3.05	--	104	.08	.37	.31
7/21-8/5...	1.42	2.55	3.50	95	.06	.24	.27
8/5-8/19...	3.37	0	0	87	.15	.26	.22
8/19-9/1...	.63	0	0	92	.15	.11	.11

Unirrigated corn began showing moisture stress symptoms of rolled leaves and reduced growth rate in late June. When the second irrigation was applied to W_2 July 16, plants were fully tasseled on irrigated plots, but tassels were just emerging on unirrigated plots.

According to moisture block readings, soil moisture under one replicate of unirrigated corn was at field capacity at the 2.5-foot depth until July 20 and at the 3.5-foot depth until July 30. Corn on these plots was unable to use water from this reserve at a rate commensurate with need. This was probably due, in part at least, to the difficulty of roots penetrating the claypan in this soil. Resulting yields are shown in the table that follows.

Corn* yields associated with two nitrogen fertilizer treatments, two irrigation treatments, and no irrigation, McCredie Farm, Missouri, 1954

Irrigation treatment		Nitrogen applied per acre	Yield per acre
Designation	Amount		
	Inches	*Pounds*	*Bushels*
W_1	0	125	0.4
		245	0.8
W_2	8.43	125	69.0
		245	82.0
W_3	7.05	125	75.1
		245	75.0

*Variety: US523W; population: 14,224 stalks per acre.

Nebraska

WATER USE AND EXTRACTION PATTERN BY BEANS VARIES WITH SEASON

O. W. Howe, Mitchell. --The accompanying table shows the total water use and the percent of the total that was taken from the different depths in the soil by field beans in experiments conducted in 1933 and 1954.

As indicated by the footnotes to this table the treatments for which moisture extraction patterns were determined do not necessarily represent the best timing of the given number of irrigations.

The following points were noted in comparing the 1953 and 1954 data:

1. About four inches less water was required in 1953 than in 1954 to produce corresponding yields of beans. For maximum yields about 12 inches was required in 1953 and 16 inches in 1954. This difference could be caused chiefly by less rain and lower temperatures in 1953. Fourteen rains contributed 2.9 inches of moisture to crop use in 1953. Thirty-five rains supplied 6.9 inches in 1954. Mean July-August temperature was 71 degrees in 1953, 74 degrees in 1954.

2. Only in non-irrigated plots was the greater rainfall in 1954 reflected in a greater percent of water use from the 0-18 inch depth. Beans with two irrigations had almost identical extraction patterns for the two years. High moisture plots removed a greater proportion of water from the top soil in 1953 and 1954 in spite of the greater rainfall in 1954.

Influence of number of irrigations on percentage of water used from the various depths by Great Northern Field Beans, Mitchell, Nebr., 1953 and 1954

Treatment number	Number of irrigations	Seasonal water use	Yield per acre	Percentage of water used from depth of -				
				0-18"[1]	18-30"	30-42"	42-54"	54-66"
			1953					
		Inches	*Bushels*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
1.....	4	12.2	39.2	88	12	0	0	
5.....	3	10.8	[2] 36.6	88	12	0	0	
13.....	2	9.6	38.7	81	12	2	5	
22.....	0	7.5	32.9	64	14	10	12	
			1954					
15.....	5	17.9	43.3	81	14	3	2	0
6.....	4	[3] 18.9	43.8	74	13	6	7	0
17.....	2	14.3	[4] 34.8	81	10	4	4	1
25.....	2	13.6	[4] 36.9	82	11	4	3	0
19.....	0	10.8	26.9	77	8	7	5	3

[1] Includes precipitation.
[2] Better timing of three irrigations resulted in yield of 43.6 bushels per acre.
[3] This value appears to be out of line. Under the other treatment of four irrigations for use was measured, only 16.2 inches was used, producing a yield of 44.1 bushels per acre.
[4] Better timing of two irrigations resulted in 39.7 bushels per acre with about the same total water use.

OATS COVER CROP EXCELS IN FORAGE AND ROOT PRODUCTION

P. Earl Ross, Weslaco. --Cover crops of Victor oats, Willamette vetch, Hubam clover, and English peas are being compared for use in a cropping system of continuous irrigated cotton. Some results obtained prior to planting cotton in 1955 are reported here.

Forage yields of cover crops were taken 90 days after planting. As shown in the accompanying table, oats produced the highest tonnage of top growth of the four crops. Oats and English peas had made near maximum growth, but the Hubam clover would have made considerably more growth if it had been allowed to grow longer. It was necessary to destroy the crop at that time, however, in order to plant the cotton.

Forage yield of 4 cover crops, Weslaco, Tex.

Crops	Yield per acre	
	Green weight	Dry weight
	Tons	*Tons*
Oats (Victor grain).....	15.4	2.5
Vetch (Willamette).....	11.5	2.2
Clover (Hubam).....	10.3	1.8
Peas (English).....	11.9	1.6

Root distribution patterns and number of roots for each crop were examined in the soil profile immediately preceding the shredding of the crops by extracting samples from the vertical walls of pits excavated across the rows. The samples were taken on six-inch spacings both vertically and horizontally with the cutting tip of a Pomona sampling unit which is two inches in diameter.

Possibly the most striking thing in the accompanying data is the performance of oat roots. Oat roots grew through the compacted zone in the soil profile at a depth of 5 to 18 inches much better than the other crops. However, if time had permitted, the volume of Hubam clover roots would no doubt have increased in all depths. The vetch roots were very outstanding in the shallow depths and apparently fixed more nitrogen than the other legumes.

Root distribution patterns of cover crops 90 days old, Weslaco, Tex.

Depth of samples (inches)	Number of roots in samples under each crop			
	Oats	Hubam clover	Vetch	Peas
3.....	91	48	108	38
6.....	38	25	26	20
12.....	33	18	15	17
18.....	42	11	7	6
24.....	38	9	5	6
30.....	31	9	12	5
36.....	22	11	1	6
42.....	16	8	3	7
48.....	13	6	1	1
54.....	10	2	3	2
60.....	4	4	0	0
66.....	1	0	0	0

Soil moisture depletion patterns of the cover crops was studied immediately preceding cotton planting for the period from January 5 to February 3. Of particular interest is the relatively small difference in the amount of soil moisture lost from check plots and from those with the cover crop. The losses from cover crop plots exceeded losses from check plots approximately as follows: Vetch 10 percent, Peas 15 percent, Oats 28 percent, Clover 30 percent.

The critical period in which the soil moisture must be followed closely is during January and early February or the period in which the pre-cotton planting irrigation must be made. It is of particular importance to manage the irrigation during this period in such a manner that the implements used in destroying the cover crops will not be working in wet soils. However, adequate moisture must be available to insure good emergence of cotton. Indications from this year's experiments are that possibly the best practice is to shred the cover crops ahead of the pre-cotton planting irrigation. This practice will shorten the growing period of the cover crops some two weeks but gives better assurance of a good stand.

Water intake rate measurements were made by means of the concentric ring method in all plots shortly before the cover crops were cut. The data indicate no marked effects of the cover crops on intake rates although intake rates from the oat plots were greater than from the other plots. The intake rates will be measured again after the cover crop residues and roots have decomposed.

Utah

ADJUST SIDESLOPE OF CANALS TO PROVIDE STABILITY OF COVER MATERIAL

C. W. Lauritzen, Frank W. Haws, Allan S. Humpherys. --The slidings of cover material on the sideslopes of canals and reservoirs lined with smooth plastic resulted in a study to determine the stable slope or the slope at which a sand cover would remain on the film without sliding. These tests were made in a small channel at the River Laboratory and also in the concrete-curing tank in the materials-testing laboratory. The film was tacked to a board about 21 inches wide which could be adjusted to provide a range of sideslopes. A 1 to 2-inch layer of washed sand was placed on the film-covered board, the board immersed in water, and the slope varied until the maximum slope was found at which the sand would not slide. The slope at which a discontinuous cover would remain in place without sliding was considered the stable slope. The stable slope thus determined is the maximum slope recommended. A cover is considered to be discontinuous if it is separated from the cover material at the base of the slope.

Two methods of increasing the stability of the cover on polyethylene were investigated:

1. Treating film with a sprayed asphaltic coating.

2. Embossing the film.

For comparative purposes, a Johns-Manville asphaltic liner was also included in the tests.

The results of the tests indicated that the stable slope for the embossed film is 2 1/4 horizontal to 1 vertical; whereas, for the plain film it is 2 3/4 horizontal to 1 vertical. The stable slope for the embossed film is the same as for the Johns-Manville liner or plain polyethylene film coated with asphalt.

Stability of sand cover on lining materials on inclined sideslopes

Material	Stability of cover[1] on sideslope of-				
	1 3/4:1	2:1	2 1/4:1	2 1/2:1	2 3/4:1
Polyethylene.....	Unstable	Unstable	Fair	Fair	Stable
Polyethylene coated with asphalt.....	Poor	Fair	Stable	Stable	Stable
Embossed polyethylene....	Poor	Fair	Stable	Stable	Stable
Johns-Manville....	Poor	Fair	Stable	Stable	Stable
Polyvinyl chloride VU-5965 olive 06	Unstable	Fair	Fair	Stable	Stable

[1] Poor--Cover material would just stay on the slope if the slope was completely covered and the material on the slope received support from that below. Any slight disturbance would cause sliding.

Fair--Cover material stayed on the slope if the cover was continuous to the bottom of the slope, thus giving support to that above. A discontinuous cover would slide but approached equilibrium between retaining forces and those causing sliding.

Stable--Cover material would stay on the sideslope when the cover was discontinuous to the bottom. Support from cover material below was not required.

Utah

SOME CANAL LINING MATERIALS RESIST PENETRATION BY ROOTS

C. W. Lauritzen, Frank W. Haws, Allan S. Humpherys, Logan. --On November 7, 1954, quack grass was planted in boxes containing barriers of prefabricated asphalt, polyvinyl chloride film, and polyethylene film. On February 12, 1955, the soil was washed away from the roots and the effects of the sharp-pointed roots noted. It was observed that the only material that was readily penetrated by the roots was the 4 and 8 mil vinyl chloride film. In the other materials tested, penetration occurred only at the corners or edges where the material had been tightly clamped between adjoining sections of the root penetration boxes. The film may have been damaged at these points, allowing the roots to penetrate more easily. For this reason, the test is being repeated and a special effort is being made to protect the lining by installing a felt cushion between the lining and the box. Results are summarized in the accompanying table.

At the same time that the quack grass was planted in the root penetration boxes, cattail roots were planted in a different set of boxes. These were planted between the film barriers. The soil in these boxes was washed away on March 5, 1955, and the effects of the sprouts noted. The cattail sprouts did not penetrate any of the lining materials. Several indentations were made in the asphaltic materials but were not sufficient to cause the material to rupture.

Penetration of liners by quack grass roots

Container no.	Material	Condition
1.....	Johns-Manville	No penetration except at edge and corner.
2.....	Fiber glass	No penetration except at corners.
3.....	Black polyethylene 4 mil	No penetration.
4.....	Black polyethylene 8 mil	No penetration except at corners
5.....	Polyvinyl chloride VUWC-59027 - blue 116 4 mil	Penetrated both membranes.
6.....	Polyvinyl chloride VUWC-59027 - blue 116 8 mil	Penetrated.

Utah

EACH SOIL TO BE STABILIZED NEEDS OWN STABILIZER MIXTURE

C. W. Lauritzen, Frank W. Haws, Allan S. Humpherys. --Studies have been continued in the laboratory to determine the best method of applying Stabilizer AM 955 to stabilize soil and rend it impervious to water. Considerable work has been done in the laboratory with soil collected from the project sites to design a satisfactory stabilizing mix for each soil. Recent work has indicated that the soil texture greatly influences the degree of stabilization and the amount of stabilizer required. It is necessary, therefore, to design a stabilizing mix for each soil.

Soil stabilized and compacted at optimum moisture probably will be the most effective in controlling seepage losses from canals. Therefore, most laboratory work has been done with compacted soil. Results indicate that a poorly graded soil containing few fines requires a higher concentration of stabilizer and activator than a well-graded soil. A greater degree of compaction is also required to stabilize a poorly-graded soil.

Results indicate that the pore space occupied by air in a compacted soil cannot exceed approximately 10 percent, if satisfactory stabilization is to be obtained.

Results also indicate that pouring the stabilizing solution onto the soil surface, in most cases, produces unsatisfactory stabilization. The soil when wet becomes very spongy, swells considerably, and shrinks upon drying.

Some soil specimens are being subjected to a freeze-thaw test. After 25 cycles, the test specimens show no deterioration.

Some exploratory studies were made with calcium acrylate, and it was found that for the sandy soils used, approximately 4 times as much calcium acrylate as Stabilizer AM 955 was required to produce satisfactory results. This higher required concentration of calcium acrylate, plus the higher cost of the chemical, renders its use questionable.

Utah

CONSUMPTIVE USE STUDIES DETERMINE IRRIGATION WATER REQUIREMENTS

Wayne D. Criddle, Logan. --The cooperative project on consumptive use and irrigation water requirements that has been underway in the Milford Valley of Utah since 1950 is being completed and a final report is being prepared. Irrigation water in this valley comes mainly from underground sources. The groundwater table has been lowered, and costs of

pumping have increased. Many pumps have been pulled, the wells deepened, and the bowls lowered. The State Engineer of Utah has closed the valley to further well development but the question remains: Will the water table level stabilize under present recharge and withdrawal conditions?

Water consumption in the valley has been measured in this study by the "inflow-outflow" method and by the "integration" method. Unit values of crop consumptive use were measured by the soil moisture depeletion method. There are 34,000 acres of land in the study area, and experimental data were available for crops and other uses on some 28,000 acres. For the additional 6,000 acres, all in native vegetation, it was necessary to estimate the use rate.

Total valley consumptive use, as determined by the integration method was about 65,000 acre-feet per year, whereas measured use within the area by the inflow-outflow method was 63,000 acre-feet--a variation of about 2 1/2 percent. Of this total, precipitation while amounting to less than 9 inches, still supplied about one-third of the annual consumptive use requirement of the valley.

Idaho

IRRIGATION METHOD INFLUENCES CONSUMPTIVE USE OF WATER BY MIXED HAY

Claude H. Pair, Boise. --The consumptive use of water by first-year alfalfa and hard fescue grass mixture under sprinkler, furrow, downslope border, and contour border irrigation methods is shown in the table that follows. The alfalfa and grass mixture was seeded in the fall of 1953. Changes in soil moisture levels before and after each irrigation were used in computing the consumptive use.

Consumptive use of water by first year alfalfa and hard fescue grass, under four irrigation methods, Black Canyon Experimental Tract, Caldwell, Idaho, 1954

Irrigation method	Consumptive use	Growing season precipitation	Net irrigation water
	Inches	*Inches*	*Inches*
Sprinkler.....	21.6	2.9	18.7
Downslope furrows	22.6	2.9	19.7
Downslope borders	20.2	2.9	17.4
Contour borders..	23.7	2.9	21.8

Washington

SPINDLING, CRACKING OF POTATOES PRODUCED BY MOISTURE STRESS

J. S. Robins and C. E. Domingo, Prosser. -- Irrigation research with potatoes in 1953 indicated that moisture stress, particularly when occurring mid-season or earlier, resulted in a high incidence of spindled tubers. Moderately severe moisture stress, occurring after tuber initiation but relatively early in the season, followed by adequate moisture produced growth cracks. Knobby second growth was unaffected by any of 12 moisture treatments but was markedly increased by reducing the number of stems per hill.

Two experiments in 1954, one at Prosser and one at the Moses Lake Development Farm gave confirmatory evidence on these quality factors. Results are shown in the table that follows.

Potato yield and quality in irrigation interval experiments Moses Lake and Prosser, Wash., 1954

Location and treatment	Total yield per acre	Yield per acre of No. 1 grade	Tubers with Spindling	Knobby second-growth	Growth cracking
Moses Lake	*Tons*	*Tons*	*Percent*	*Percent*	*Percent*
Control.....	20.2	13.4	25.0	2.8	5.1
Moderate Stress	15.1	7.3	39.0	3.0	7.1
Severe Stress..	14.1	5.4	50.0	4.4	6.7
Prosser					
Control.....	22.0	18.7	23.0	2.5	0.4
Moderate Stress	19.5	16.6	42.0	3.0	0.3
Severe Stress..	19.0	14.5	56.0	4.8	3.1

Oregon

WATER SHORTAGE EMPHASIZES NEED TO SELECT CROPS, PRACTICES

Fred M. Tileston, Ontario. --Improved irrigation practices and possibly some crop changes will be required if good crops are to be grown in the Owyhee Irrigation Project of Eastern Oregon in 1955 with the available supply of water. It has been estimated that only 42 to 48 inches of water will be available to users in 1955 compared with 54 inches in 1954, which was the average amount available during the last 126 years.

In adapting to the water shortage, growers have available the data on water requirements of various crops gathered in irrigation studies in the project, along with computed requirements. (See table.) These data, along with irrigation management information, should be useful to irrigation farmers in making the best use of the limited supply of irrigation water during 1954.

Seasonal consumptive use requirements of certain crops in Owyhee Irrigation Project area, Eastern Oregon.

Crop	Consumptive use of water (irrigation plus rainfall)	
	Estimated	Measured*
	Inches	*Inches*
Alfalfa.....	29.2	36.8
Pasture.....	27.5	34.7
Red Clover.....	27.5	34.0
Sugar Beets.....	25.8	29.7
Corn.....	23.3	23.0
Small grains.....	17.3	19.6
Potatoes.....	20.6	15.1

*500 measured values

California

SLOPING BED PLANTINGS FAVOR EMERGENCE OF SOYBEANS ON SALINE SOILS

K. R. Stockinger and A. J. MacKenzie, Brawley. --Soybeans are a new crop in irrigated sections of the Southwest. Until the development of the Lee variety of soybeans by Hartwig and his associates, all commercial varieties of soybeans shattered under the hot dry climatic conditions of this region. Consequently, there is no grower experience or experimental results to indicate the best procedures to use in planting and growing the crop. Several cultural experiments were set up in 1954 to answer some of these questions, and a preliminary report of these tests is given below. These studies were all carried out in cooperation with Mr. George Abel of the Section of Forage and Range.

One of the most critical problems to be studied was the salt tolerance of soybeans. An experiment was set up in which the soybeans were planted in pre-salinized soil on various bed shapes and then irrigated with Colorado River water to obtain emergence. Four initial salinity levels were established ranging from an electrical conductivity value of the saturation extract of 5.0 to 25.4 millimhos/cm. Emergence was reduced at all levels of salinity when the seed was planted in the center of the bed. When shoulder or sloping bed plantings were made, emergence held up well even at the top salinity level. Later irrigations with water containing 3000 and 6000 p.p.m. additional salt (50-50 mixture of sodium and calcium chloride) resulted in a marked depression in plant height and yield. These results indicate that stands of soybeans can be obtained on saline soils by use of shoulder plantings or sloping beds but that yields will still be reduced unless the salinity is reduced by subsequent irrigations.

Soil moisture level, row spacing, and plant spacing within the row were studied in another experiment. Neither row spacing or plant spacing had any effect on yield. Maintaining the soil moisture at higher levels by more frequent irrigations, however, resulted in increased yields. Yields were not affected by reducing the level of soil moisture during the flowering period. The best yields (26 bushels per acre) were made by maintaining the soil moisture tension below 1/3 atmosphere throughout the season. If the tension was allowed to increase to 6 atmosphere before irrigation, yields were reduced to 18 bu./A.

Fertility studies were also made on inoculated soybeans. None of the fertilizer treatments--containing nitrogen, phosphorus, potassium, or fritted trace elements--had any significant effect on yield of soybeans. These soybeans were well nodulated and were planted on soil which has not given response to phosphorus or potassium in the past when planted to other crops.

California

MOSQUITO POPULATION RELATED TO IRRIGATION EFFICIENCY

Sterling Davis and Richard C. Husbands, Merced. -- An irrigation-mosquito study near Merced was conducted in cooperation with Bureau of Vector Control, California Department of Public Health and California Mosquito Control Association.

The principal objectives of the study are as follows:

(1) To evaluate present irrigation practices and establish the relationship between irrigation efficiency and mosquito production.

(2) To provide information for proper irrigation layouts or operation to increase the low efficiencies.

(3) To provide information on the relationships between crop production, mosquito production, and irrigation efficiency.

After a field survey, three fields of irrigated pasture with soils of low intake rate of water were selected for the study. These "tight" soils and pasture crops predominate in the area.

Irrigation efficiencies were determined on these fields by taking soil moisture samples before and after each irrigation and measuring the amount of water applied. One field with only 25 percent irrigation efficiency (25 percent of the water applied going into crop production) raised numerous mosquitoes. Another field with an efficiency of 35 percent produced quite a lot of mosquitoes. A field with 66 percent irrigation efficiency raised practically no mosquitoes.

Analysis of mosquito and irrigation data and tentative recommendations for improving irrigation practices are presented in a mimeographed progress report by Sterling Davis and Richard C. Husbands, Entomologist, California Mosquito Control Association, Inc.

California

CHLORINATION OF WATER INCREASES INFILTRATION RATE

Curtis E. Johnson, Bakersfield. --Previous studies have shown that during prolonged flooding of a soil, the infiltration rate at first declines (in the first day or two) then increases to a maximum (in about 30 days) and finally declines as the period of submergence continues. The decline following the maximum infiltration rate has been attributed to the clogging of soil pores by micro-organisms and their growth products such as gases, slimes and gums.

A study was begun to determine whether a germicide such as chlorine could be used to maintain the peak rate of infiltration by preventing the clogging due to microbial activity within the submerged soil. The pond selected for the test was 218 square feet or 0.005 acre in size and circular in shape. The metal sides extend approximately nine inches into the soil. This pond was equipped with a water level recorder, float valve, water meter, staff gage and the apparatus necessary for chlorinating the water supply. No previous treatment had been imposed on the soil. However, three test periods of submergence with nonchlorinated well water had been made during the prior six year period.

With chlorinated water, the maximum infiltration rate was higher than that reached when the water was not chlorinated. Apparently the low chlorination rate had some effect on inhibiting microbial activity in the surface so that a higher peak rate was reached. However, the infiltration rate on the chlorination test run declined after the peak was achieved. Preliminary results of the microbial counts indicate that the 5 ppm of chlorrine in the water during the first 36 days had not influenced microbial activity appreciably below the surface one-half inch of soil. The heavier chlorination rate of 15 ppm influenced microbial activity to a greater depth in the soil, and the infiltration rate has tended to level off or decline more slowly. Part of this decline may be a result of the oxidation of the organic material in the soil with resulting breakdown of soil structure.

The present infiltration rate of the chlorinated pond is approximately 2 feet per day above the rate of the nonchlorinated run after a like period of submergence. Present plans are to continue the test as long as rates tend to remain stable and to continue the assay of microbial activity changes in the surface six inches of soil.

Infiltration rates obtained on a 0.005 acre test pond using non-chlorinated and chlorinated water, Bakersfield, Calif., 1955

Days after start of run	Nonchlorinated water	Chlorinated water*
	ft./day	*ft./day*
2	2.28	2.08
10	3.20	2.78
20	3.80	3.34
27	4.28 (Maximum)	4.21
30	3.83	4.99
34	3.27	5.34 (Maximum)
40	2.75	4.30
50	1.25	3.30
60	0.78	2.85
70	0.93**	2.87
80	0.73	--

*Chlorine residual maintained at 5 ppm for first 36 days of run and at 15 ppm thereafter.

**Pond went dry for a few hours on the previous day.

California

INFILTRATION RATES OF WATER SPREADING AREAS AFFECTED BY SOIL TYPE

Eldred S. Bliss, Bakersfield. --A report on this subject was prepared at the request of the California State Division of Water Resources. It discusses the relationship of soil type and mechanical composition of soil to infiltration rates and includes data in support of conclusions. Briefly stated conclusions are: (1) soil type can be related to infiltration rate under water spreading conditions if limiting layers do not occur below the true soil horizons; (2) treatment or degree of manipulation of the soil can effectively increase or decrease the natural infiltration rate enough to completely mask the normal relationship; (3) mechanical composition of the soil is only one variable (though an important one) determining infiltration rates and cannot be used as an index for estimating potential rates on an area.

California

SANTA CLARA BASIN HAS INADEQUATE UNDERGROUND STORAGE

Gilbert L. Corey and Harry F. Blaney, Los Angeles. --A study has been made for the following purposes in the Upper Santa Clara Soil Conservation District: To inventory the irrigation water supply; to determine the present use of water by agricultural crops; and to investigate the possibilities of conserving the available supplies.

A final report covering this work is being prepared and soon will be available to the Soil Conservation Service and the District. On the basis of field investigations and analysis of data, the following conclusions were made:

1. The fluctuations of ground-water tables in the district are coincident with rainfall cycles.

2. The underground basins, from which water is currently being withdrawn, are low in capacity.

3. The mean basin-wide hydrologic balance shows an excess of water. However, most of this excess occurs during wet cycles and is lost from the area as runoff. Since the aquifers are small, there is not enough water stored during wet years to insure an adequate supply during dry years.

The ultimate development of the Upper Santa Clara District would depend upon the following:

1. Facilities to develop and extract more of the ultimate underground supply during dry years. Perhaps there are deeper aquifers. The possibility of drilling deeper wells should be investigated.

2. Facilities to insure the complete recharge of the underground reservoirs during wet years. However, water spreading is questionable since the underground basins are small.

3. Facilities for surface storage of excess watershed yield now leaving the basin as surface runoff.

California

NEW COEFFICIENTS CONVERT PAN EVAPORATION TO LAKE EVAPORATION

Dean C. Muckel, Berkeley. --A study of evaporation and consumptive use of water in the San Francisco Bay area, undertaken in cooperation with the California State Division of Water Resources, is complete, and a final report is now being prepared.

One phase of the study was the determination of a reduction factor applicable to the evaporation pan measurements to obtain the actual rate of evaporation from a lake surface. The following table shows the monthly and annual reduction factors as determined by the study:

Monthly reduction coefficients for converting evaporation from a Weather Bureau-type pan to evaporation from a lake surface.

Month	Coefficient	Month	Coefficient	Month	Coefficient
Jan.....	0.60	May.....	0.75	Sep....	0.75
Feb.....	.70	June....	.80	Oct....	.75
Mar.....	.70	July....	.80	Nov....	.70
Apr.....	.75	Aug.....	.80	Dec....	.65
				Annual	.75

California

SOIL MOISTURE METER STUDIED--NOT SUITABLE FOR VERY SANDY SOIL

V. S. Aronovici, Pomona. --A preliminary study of a soil moisture meter which utilizes a small cylindrically shaped plaster of paris block was completed. The purpose of the study was to determine the practical value of this unit in the citrus orchards of Southern California.

It was found that the equipment has the same advantages and shortcomings of a number of other moisture cells. Typically, the instrument is relatively ineffective at the lower tension levels. The blocks, when subjected to a series of tensions, showed little or no change in electrical resistance until tensions in excess of 750 centimeters of water were reached. This suggests that they would not be suitable for use in very sandy soils.

New York

SOIL MANAGEMENT PRACTICES AFFECT DEPTH OF SOIL FREEZING

G. R. Free, Ithaca. --Runoff during winter and early spring in New York is far greater than during the growing season. At the lower elevations, sheet erosion is often serious on exposed soil frozen below but thawed on the surface. Control of frost penetration through soil management would seem to offer possibilities for diminishing runoff and erosion during this critical period.

Last winter, on a well-drained Honeoye silt loam at Marcellus, soil was frozen to a depth of 6 to 8 inches on a field where cabbage had been grown the previous summer with the use of ordinary soil management practices. However, the soil was frozen only to a depth of 1 to 2 inches on adjacent plots which had received a surface application of wood chips at 10 tons per acre the preceding spring and in which soil was mixed by cultivation during the 1954 growing season. Similar but less marked differences were noted during the 1953-54 winter. In another experiment a difference in depth of soil freezing of more than 1 inch was noted between plots turn-plowed and plots stubble mulch-plowed for fall seeding of wheat following oats.

The logical explanation for these differences is the effect of the chips or residues on the bulk density or compactness of soil at the surface and hence an effect on its insulating characteristics. The practical significance and application of this needs further study, but these data do indicate some promise for decreasing winter and early spring erosion in northern areas.

Kansas

SOIL ERODIBILITY DOWN, THEN UP AS ORGANIC MATTER DECOMPOSES

W. S. Chepil, Manhattan. --In October 1948, June 1949, and January 1950 dry wheat straw and freshly cut alfalfa were added to 6-pound samples of soil from the black, chestnut, and reddish-chestnut soil zones of Kansas. The soils were analyzed at irregular intervals for a period of years for some structural characteristics and erodibility by wind. The results are summarized as follows:

Decomposing vegetative matter in the form of wheat straw or green alfalfa increased the proportion of water-stable aggregates greater than 0.84 mm. in diameter; decreased the proportion of water-stable particles smaller than 0.02 mm.; slightly increased the proportion of dry soil clods greater than 0.84 mm.; and slightly decreased erodibility of soil by wind. The effects of the larger amounts of added vegetative matter were greater than the effects of smaller amounts.

Increases in soil aggregation were not discernible until after decomposition of vegetative matter began. The aggregating effects were apparently due to mucilaginous products of decomposition and not particularly to the binding action of vegetative fibers incorporated in the soil. Many of the aggregates formed from decomposition of the vegetative matter were of the size resistant to erosion by wind.

Gradually, the initial products of decomposition appeared to lose their mucilaginous property or to be destroyed and replaced by secondary decomposition products. Mechanical forces of expansion and contraction of the soil by wetting and drying and especially by freezing and thawing during the winter caused the secondary cements to break up and the coarse primary and secondary aggregates to disintegrate into a more or less finely granulated condition. Many of the resultant granules were essentially water-stable.

They formed a friable, mellow soil but, unfortunately, a soil more erodible by wind. Thus, three or more years after the last increment of vegetative matter was added to the soil, there was a decrease in the proportion of water-stable aggregates greater than 0.84 mm., an increase in the proportion of water-stable particles smaller than 0.02 mm. a decrease in soil cloddiness, and an increase in erodibility by wind.

It was concluded, therefore, that the greatest benefits against wind erosion would be derived from continual replenishment of vegetative matter to the soil. No doubt, continual additions of vegetative matter would tend to produce some wind-resistant aggregates and would tend to counterbalance excessive granulation and increased wind-erodibility caused by the secondary products of decomposition. This study indicates the benefits obtained from the primary products of decomposition in augmenting resistance of soil to wind erosion are small. A far greater benefit, no doubt, would be derived by leaving as much of the vegetative matter as possible anchored on top of the ground where it would protect the soil surface from the wind. As the vegetative matter decomposed, the initial products of decomposition would have some tendency to form wind-resistant aggregates at the surface of the ground where they would do the most good.

Kansas

SHELTERBELT SYSTEM TO USE DEPENDS UPON PROBLEM

N. P. Woodruff, Manhattan. --A technical paper covering the results of the study of the spacing interval for different combinations of principal and supplemental shelterbelts was prepared during the quarter. A summary follows:

Wind tunnel studies were conducted to obtain information on the mechanical reduction of wind velocity with a system of shelterbelts consisting of a principal belt followed by supplemental belts. Models of 7-, 3-, and 1-row principal belts, and 1-, 2-, and 3-row supplemental belts were used to obtain the information. Results are expressed in terms of percentage reduction of the open wind velocity. Information was obtained with several different spacings of supplemental belts when used with a principal belt. Some results of tests on the so-called "narrow" plantings, i.e., single rows used without the benefit of a wide principal belt, are also given.

The degree of efficiency of a given system of belts depended somewhat upon the type of protection desired. Of the belts tested, a 7-row principal followed by a system of 1-row supplementals would give the greatest degree of protection extending to the greatest height agove ground between belts. This system would be recommended for tall crops, orchards, and possibly farmsteads and livestock protection. On the other hand, a 7-row principal belt followed by a system of 2-row supplementals would permit the greatest spacing interval between belts and would provide protection to the greatest length of ground. This system would be recommended for control of soil blowing. A 7-row principal belt followed by a system of 3-row supplemental belts would rank third in the group tested. Single rows of trees used without benefit of a wide principal belt would not reduce wind velocity as much as the wider belts. However, at lower levels of velocity reduction, they would permit fairly long spacing intervals and would provide a relatively high ratio of protected length to total length used by the system. They would be recommended for special problems where less protection from wind is required and where the area used by the belt would be an important factor. The 3-row principal followed by 1-row supplementals did not show up well in the tests and would not be recommended.

Nebraska

FALL SEEDED RYE AND VETCH DO NOT CONTROL WIND EROSION ON BEAN LAND

Lionel Harris, Mitchell. --Loss of top soil as a result of wind action during the winter and spring months in western Nebraska is a serious problem. Bean fields in particular are vulnerable. The practice of seeding fall rye after bean harvest has been used with limited success. It has not been successful on a wide scale because the rye cannot be seeded until the 10th to 15th of September, after beans are harvested. Seeding at this time has usually not produced enough fall growth to protect the soil adequately.

Vetch has been used successfully as a cover crop on sandy soils in northeastern Nebraska and elsewhere. Not much is known relative to the value of vetch in western Nebraska.

A three-acre bean field was seeded to a mixture of fall rye and vetch on September 14, 1954, at the Scotts Bluff Experiment Station. Part of the area was irrigated shortly after planting. On the non-irrigated area, the fall growth of both rye and vetch was poor, and on the irrigated area it was only fair. The growth of vetch was inferior to rye on both areas. Disking the soil on adjacent areas protected the soil against wind erosion better than did the growth of these two cover crops. The spring growth of vetch and rye has not been great enough to protect the soil during high winds which occurred in late March, 1955.

From the results of this observational planting, fall rye appears to be a better adapted cover crop for western Nebraska than vetch. To be successful, even rye would have to be seeded earlier than the middle of September.

Washington

CLODDY SOIL SURFACE REDUCES WIND EROSION IN COLUMBIA BASIN

Stephen J. Mech, Prosser. --The development of a cloddy soil surface by better timing of the ordinary cultivation operations is a very promising means of reducing wind erosion on irrigated Columbia Basin soils. Tilling these sandy soils at a time when their soil moisture content is high presses many of the single-grain soil particles into small clods or crumbs large enough to resist movement by wind. Once the desirable "cloddy" surface is established, tillage performed when the soil moisture is low will tend to break down the clods. Tires and rollers, particularly, tend to pulverize the soil and increase the erosion hazard.

Tillage of these sandy soils when they are wet does not appear to have any adverse effect on soil structure. The clods are fragile and very little force is required to break them.

Soil clods or crumbs become less effective with time. The climatic elements tend to break them down. Water in an irrigation furrow will "melt" the clods within its reach. Under sprinkler irrigation, the impact of falling water tends to break down the clods into single-grain particles.

It is impractical to irrigate often enough to prevent soil blowing. When the surface dries out to a depth of two soil particles, the top one will "blow." The depth of drying may be only a minute fraction of an inch and the soil below this dry surface may be wet; but, if the surface is dry and the wind blows, it will erode unless the soil particles are consolidated into clods or protected by vegetation.

Straw and similar crop residues when disced on the surface offer good protection from wind erosion. They are recommended for spot control; on the other hand, the volunteer growth usually accompanying the use of straw can be very objectionable in low-

growing row crops. A surface application of wheat straw to a bean field gave excellent protection against wind erosion, but the crop was almost a complete loss because volunteer wheat growth in the rows not only retarded the beans but made harvesting with a combine impossible.

At no time should more new land be developed for irrigation than can be handled properly by the operator. The multitude of problems and unanticipated delays common to the development of new land throw an additional burden on the farmer and often preclude timeliness of operations. Delayed planting and over-extension of farming operations have often resulted in complete loss of crops.

Land preparation, including leveling, during the summer period is highly recommended. Summer is not only the season of lowest wind velocities, but it allows more time for establishment of the irrigation system and seeding of cover crops. Spring, on the other hand, is the period of greatest erosion hazard: the wind velocities are highest and vegetative protection is at its lowest. Doing part of the leveling during the preceding summer or fall, or delaying a portion of it until the following summer, will diminish the spring work load. Planting and cultivation can be done at the most favorable times, thereby improving yield prospects.

Washington

FREEZING OF WINTER WHEAT LAND INCREASES WINTER RUNOFF

Glenn M. Horner, Pullman. --The 1953-54 winter runoff season's precipitation was below normal and consisted primarily of snow, which was unevenly distributed by drifting. The exposed south and west slopes were bare of snow during most of the periods when thawing occurred, while land with other exposures generally had a snow cover throughout the winter.

Freezing of the soil had a marked effect on the amount of runoff from a particular area. There was considerable variation in the amount of frozen soil on the different types of exposures. North-facing slopes were frozen continuously from December until the end of March, while the upper south slopes thawed periodically during this period.

Runoff and soil loss data from two groups of plots were summarized for the period December-March, 1954-55. Of significance is the large difference in the amount of runoff from the two exposures that had the same type of cover conditions. Only 0.04 inch of runoff occurred on the south-sloping crop rotation plots compared with an average of 3.54 inches from the north-sloping clover plots. The rotation plots had little or no snow cover and were not appreciably frozen during the runoff periods. Frozen soil and a deeper snow cover on the clover plots caused a large amount of runoff. Soil loss from the north-sloping plots was only 0.01 ton per acre compared with 0.65 ton per acre from the south-sloping plots.

SOIL FERTILITY

Pennsylvania

FERTILIZERS INCREASE EFFICIENCY OF MOISTURE USE BY TWO CROPS

R. R. Robinson, State College. --The results of two experiments conducted at State College, Pa. show that except in very dry years alfalfa and orchardgrass production can be greatly increased during midsummer by adequate fertilization. If the soil is well fertilized, growth will start immediately following a rain and will continue until the available moisture is depleted. At low levels of soil fertility, the water will be transpired at almost the same rate but growth will be poor, even during the period when soil moisture is adequate.

In one experiment, plots small enough to be protected with portable covers during periods of rainfall were used last year to investigate the effect of soil moisture on growth of pure stands of alfalfa and orchardgrass, both of which were liberally fertilized. Some plots were irrigated all summer while others received no water for serveral weeks. All plots were then clipped and irrigated so that soil moisture was brought to optimum level. The plants that had been subjected to severe drought recovered immediately, and in the next cutting yields were so high as on the plots that had been irrigated all summer.

In another experiment, conducted previously, yields of orchardgrass on a Hagerstown silt loam receiving 500 pounds per acre per year of 0-20-20 were compared with yields of orchardgrass receiving this fertilizer treatment plus 40 pounds of N per acre after each cutting. Rainfall was somewhat below normal, and yields were limited by lack of water. During July 1 to September 30, the yields of dry grass were 330 pounds per acre from plots receiving phosphate and potash as compared with 1,950 pounds for the plots that received all three nutrients. Soil moisture at the end of the season was below the wilting point to a depth of about two feet on all plots.

Ohio

SOIL PRACTICES AFFECT NUTRIENT LOSSES

F. R. Dreibelbis and L. L. Harrold, Coshocton.--The average annual percolation from monolith lysimeters was considerably below normal both in 1953 and 1954 because of the large deficiencies in rainfall during these years. When percolation is low, the loss of plant nutrients through this means is also reduced. A comparison of some of the plant nutrients in lysimeter percolates is given in the accompanying table.

Losses of all nutrients in 1953 and 1954 were considerably below the average of 1940-54. A comparison of nutrient losses under both conservation practices and poor practice can also be made from these data. Losses of calcium, magnesium, and sulfur are greater where conservation practices are used. This is largely a reflection of the greater application of limestone and fertilizer. From the poor-practice areas losses of potassium and nitrogen are greater, probably because the plants are smaller in size on these areas and absorb less of these nutrients. Also, limestone applications have a repressive effect on potassium losses in leachates. The greater loss of manganese from the poor practice area is likely due to the greater solubility of manganese from these soils because they are more acid than those on the conservation practice areas.

Some plant nutrients in lysimeter percolates from Keene silt loam, 1953, 1954 and 1940-54 averages, Coshocton, Ohio

Period and conditions				Nutrients per acre					
Years	Type of practice	Precip-itation	Perco-lation	Ca	Mg	K	N	Mn	S
		Inches	*Inches*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
1953.....	Conservation	28.20	3.54	5.88	0.74	2.77	0.64	0.13	8.27
1954.....	Conservation	31.67	1.52	4.28	2.42	2.94	1.58	.05	4.05
Average 1940-1954*	Conservation	37.53	6.25	22.92	18.00	10.18	3.56	.28	31.72
1953.....	Poor	28.20	5.04	4.59	0.68	3.61	1.18	0.19	12.51
1954.....	Poor	31.67	3.11	6.62	3.19	6.04	2.88	.14	6.54
Average 1940-1954*	Poor	37.53	6.80	17.80	13.12	14.65	4.26	.38	21.66

*Data for 1946 not included because no percolate samples were collected in 1946.

Nebraska

CORN YIELDS INFLUENCED MATERIALLY BY PLANTING-TIME MOISTURE

R. E. Ramig and F. E. Koehler, North Platte. -- As a basis for better understanding of the nitrogen fertilizer requirements of dryland corn in the semi-arid Great Plains, a study was initiated in 1954 to determine the relationship between nitrogen treatments and available soil moisture at planting time. This experiment is being conducted on Holdrege very fine sandy loam with a pH of 6.1 and a total nitrogen percentage in the surface soil of 0.091. The surface 22 inches of soil was wet to field capacity when the variable moisture levels were established by contour furrow irrigation in April. A randomized complete block design was used with moisture treatments wetting the surface 2, 4, or 6 feet to field carrying capacity. Fertilizer treatments were none, 20, 40, and 80 pounds of nitrogen per acre sidedressed on July 2 at a corn height of 14-16 inches.

As averages of the four replications, 2.93 and 4.73 inches of additional water were required to wet to depths of four and six feet. Nebraska 301 corn was planted May 15 and thinned to check row stands of two plants per hill spaced forty inches apart--approximately 7,800 plants per acre.

Although the application of 80 pounds of nitrogen compared to no nitrogen increased yields five and ten bushels per acre where the soil had been wet four and six feet before planting, these differences were statistically not significant because of large variation in yield between plots. Where supplemental water had wet the soil four feet before planting, 21.2 bushels more corn were produced (as an average of all nitrogen treatments) than where no additional water was added and the soil was wet about two feet. Wetting the soil to six feet produced 7.5 bushels more corn (as an average of all nitrogen treatments) than wetting to four feet. Rates of nitrogen greater than 20 pounds did not increase yield where the soil was wet only two or four feet.

Increasing available moisture decreased the nitrogen content of the corn grain. The nitrogen content of the grain increased correspondingly as the rates of nitrogen fertilizer were increased. Although the nitrogen uptake by the plant was too late to make any significant yield differences, it was soon enough to affect the nitrogen content of the grain. It is proposed that the nitrogen side dressings be made earlier next year. Shelling percentage of the corn increased as available moisture increased.

Nebraska

NITROGEN FOR HIGH YIELDING NURSE CROP REDUCES ALFALFA STAND AND YIELD

R. R. Allmaras and F. E. Koehler, Mitchell. --Irrigation farmers of western Nebraska are vitally interested in obtaining a vigorous stand of alfalfa. They place as much importance on a proper stand of alfalfa as on a good yield of nurse crop. These farmers are interested in knowing what fertilization practice may help to give them maximum stand establishment.

In 1953 an experiment was conducted on Rotation 41 at the Scotts Bluff Experiment Farm to study the influence of nitrogen and phosphorus fertilizers on oats yield and on stand establishment and yield of alfalfa. Rotation 41 has had a cropping sequence of barley-alfalfa, alfalfa, potatoes, and sugar beets since 1912. Oats and alfalfa were sown in March using a combination grain and fertilizer drill with a grass seeder attachment. A factorial design of 12 treatments was used with three rates of nitrogen (0, 40, 80 pounds per acre) with each of four rates of phosphorus (0, 40, 80, 160 pounds of P_2O_5 per acre). Treble superphosphate was drilled with the seed and ammonium nitrate was broadcast.

Hail damage in 1953 prevented an accurate measure of fertilizer response by oats. Stands of alfalfa as affected by fertilizer practice were discussed in the last quarterly report.

Three cuttings of alfalfa were made in 1954 to measure the response of alfalfa to 1953 fertilizer treatments. There was no significant interaction between cuttings and treatments. Total yields are indicated in the accompanying table. The data indicate that the average effect of nitrogen was to decrease the yield of alfalfa approximately 600 pounds per acre for each 40-pound increment of nitrogen. This effect was attributed mainly to a reduction in stand by the nitrogen fertilizer.

At the zero rate of N, 40 pounds of P_2O_5 showed a marked increase in yield with further additions of P_2O_5 having no additional effect. At the 40-pound rate of N, the yields increased with each increment of phosphate applied. At the 80-pound rate of N. the first 40-pound increment of P_2O_5 depressed the yield; this is related to the depression in stand caused by that rate of N with only 40 pounds of P_2O_5.

These data indicate that reductions in stand due to heavy nitrogen fertilization cannot be alleviated completely by increased yields from high rates of phosphate. If the farmer wants the best stand of alfalfa, the yield of the nurse crop must be held down by low rates of N.

First-year yields of alfalfa following fertilization of nurse crop with phosphorus and nitrogen (total for 3 cuttings), Scotts Bluff Experiment station, Mitchell, Nebr., 1954

Phosphate fertilizer applied per acre (in terms of P_2O_5)	Yield of alfalfa hay[1] per acre with fertilizer N applied at per acre rate of-			Mean yield of alfalfa hay[1] per acre
	0	40 lbs.	80 lbs.	
Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*
0	8910	8300	8220	8480
40	9790	8760	7650	8730
80	9550	8940	8370	8950
160	9600	9290	8870	9250
Mean	9460	8820	8280	----

[1] 12.5 percent moisture.

New Mexico

ALFALFA AT TUCUMCARI NEEDS MORE THAN 80 POUNDS OF P_2O_5 PER YEAR

R. E. Campbell, Tucumcari. --Studies were started in 1951 to compare the effects of a certain amount of phosphate fertilizer on alfalfa yields when applied in a single application or in equal annual applications. Three fertilizer treatments were set up on a newly established stand of alfalfa. These were (1) Check, no treatments; (2) 80 pounds of P_2O_5 per acre applied each fall 1951, 1952 and 1953; (3) 240 pounds P_2O_5 per acre applied in 1951, none thereafter. Five crops of alfalfa have been harvested in each of the years 1952, 1953 and 1954.

As shown in the table below, there is an advantage in applying the entire amount of fertilizer in a single application rather than in small annual applications. The data also indicate that 80 pounds of P_2O_5 per year is not enough to maintain maximum alfalfa production in the area tested.

Alfalfa yields associated with phosphate fertilizer applied in two ways, 1952-53-54, Tucumcari, N. Mex.

P_2O_5 per acre		Yield per acre in-			
Amount	When applied	1952	1953	1954	Total
Pounds		*Tons*	*Tons*	*Tons*	*Tons*
0 (check)		1.46	0.82	0.64	2.92
80	Annually	6.08	6.44	3.71	16.23
240	1951	7.10	7.42	3.34	17.86

New Mexico

HEAVY FERTILIZATION PROLONGS FRUITING PERIOD OF COTTON

Ross W. Leamer, State College. --Many cotton growers believe that heavy applications of nitrogen fertilizers stimulate vegetative growth of the cotton plant and delay the maturity enough to reduce the total yield of cotton. Data from 14 cotton fertilizer trials scattered throughout southern New Mexico do not substantiate this belief (See accompanying table). The data do show that a smaller percentage of the total yield was picked in the first picking as the nitrogen rate increased, but in only one case in 1954 did the unfertilized plot yield significantly more at the first picking than did the plots receiving nitrogen. The total yield from the high nitrogen plots at this location was also less than from the unfertilized plots. The cotton in this trial was planted very late and was still developing bolls at the time of frost.

Cotton production resulting from different rates of phosphorus and nitrogen fertilizers* New Mexico, 1953 and 1954

Pounds P_2O_5 applied per acre	Percentage of total cotton yield obtained at first picking from different rates of N per acre-			Relative total of cotton (assuming unfertilized yeild to be 100) from different rates of N per acre		
	0	60 lbs.	120 lbs.	0	60 lbs.	120 lbs.
	Percent	*Percent*	*Percent*			
0	70	66	66	100	111	111
40	70	69	65	105	115	118
80	71	68	63	104	116	119

*Each value is a mean of 71 plots.

Yield responses of cotton to phosphorus and nitrogen fertilizers are extremely variable. In general, the highest yields have been obtained from 60 pounds of N and 40 pounds P_2O_5. The effect of the nitrogen fertilizers seems to be to provide nutrients for additional vegetative growth and thus to increase cotton yields by prolonging the fruiting period.

North Dakota

RESPONSE OF CROPS TO FERTILIZER INFLUENCED BY ROTATION

C. W. Carlson, D. L. Grunes, L. R. Jensen, J. Allessi, Mandan. --A field experiment under irrigation involving legume and nonlegume rotations and various rates of fertilizer application was initiated in the Deep River Development Farm in 1953. The legume rotation includes barley, three years of alfalfa, corn, and potatoes); the non-

legume rotation includes barley, corn, and potatoes. The major findings of this experiment to date have been as follows:

1. Barley potato yields were not increased by phosphorus fertilizer alone, they were increased with nitrogen fertilizer alone; and there was a tendency toward still higher yields where both nitrogen and phosphorus fertilizers were applied. Response to residual nitrogen (nitrogen applied in 1953) was obtained. The fertilizer treatments had no significant effect on barley grain test weight or potato quality.

2. Corn grain and forage yields indicate a different fertilizer response in the legume and nonlegume rotations. In the legume rotation nitrogen alone had no influence on corn yields while phosphorus alone increased yields slightly. Treatments which included nitrogen and phosphorus tended to yield more than with phosphorous alone. In the nonlegume rotation, corn grain and forage yields showed no increase from phosphorus alone, but nitrogen alone increased yields considerably. Phosphorus in combination with nitrogen gave no yield increase compared with the application of nitrogen alone.

3. Alfalfa showed significant yield responses to phosphorus. There was a tendency for yields to increase with increasing rates of phosphorus application.

North Dakota

ZINC DEFICIENCY ON CUT AREAS CORRECTED BY ZINC SULFATE OR MANURE

D. L. Grunes, C. W. Carlson, H. R. Haise, J. Allessi, L. R. Jensen, F. Turner, Jr., Mandan.--During the fall of 1952, the soil on the Deep River Development Farm was leveled to facilitate gravity irrigation, and in this process it was necessary to remove varying amounts of top soil from certain areas (known as cut areas).

In 1953 corn plants grown on cut areas were dwarfed and showed abnormal development despite liberal applications of nitrogen and phosphorus fertilizers. It was observed that previous applications of manure (about 20 tons per acre) in certain parts of the same field resulted in a definite improvement in crop growth. A mineral element deficiency, other than nitrogen or phosphorus, was suspected, and corn plants in unmanured portions of the field were treated with various essential elements on July 22.

Three weeks later it was apparent that the corn plants had responded only to zinc applications. There were some plants on the zinc-treated plots which showd no benefit. Had these fertilizers been applied earlier and in greater quantities, the results might have been more conclusive.

To determine whether crop yields would be increased by applications of zinc fertilizer, field experiments with corn and potatoes were initiated in 1954 on land from which surface soil had been removed.

The results of the corn experiment were as follows:

1. On non-zinc treated areas, the leaves were chlorotic between the midrib and edges. This portion of the leaves became completely white later in the season and in some instances this was followed by necrosis. On some plants, the chlorotic areas were continuous and on other plants there was a white spotting between the midrib and the edges. Where zinc dificiency was severe, there was a stunting and dying of plants. On many plants the unfolding leaves were white.

2. Zinc deficiency symptoms were corrected by either soil or spray applications of zinc sulfate.

3. Increases in corn forage yields were obtained with soil applications of zince sulfate.

4. Application of essential elements other than nitrogen, phosphorus, and zinc did not increase the yields.

5. Zinc deficiency symptoms were eliminated by the addition of manure. Those plots receiving manure gave the highest yields despite the addition of high rates of nitrogen and phosphorus to all plots.

6. Side-dressing nitrogen, phosphorus, and zinc fertilizers on this cut area gave lower yields than broadcasting the fertilizers just prior to planting.

7. There appeared to be varietal differences in susceptibility to zinc deficiency.

Results of the potato experiment were as follows:

1. There was a tendency toward increased yields due to zinc applications.

2. Manure applied in addition to nitrogen and phosphorus increased yields above those obtained on plots receiving only nitrogen and phosphorus fertilizers.

North Dakota

SOIL FERTILITY PRACTICES NOW INFLUENCE YIELDS OF DRYLAND CROPS

Howard J. Haas, Mandan. --Wheat yields for the period 1915 to 1953 have been increased where alfalfa or barnyard manure was used in the rotation. No increases were noted where sweet clover or winter rye were plowed under for green manure, when compared to ordinary fallow. These practices had little effect on the long-time average yields of corn.

Yields for the period 1915 to 1918, indicate little benefit from manure application and legumes in the cropping system with the exception of wheat on manured fallow. The highest corn yields were from continuous cropping, followed by alternate corn and fallow. Grass in the rotation apparently depressed yields of both wheat and corn. Little benefit was expected from these practices during this period, since the land was broken from native sod in 1913. Differences in yields would, in most cases, be due to moisture.

Average yields during the period 1947 to 1953, show that manure application and legumes in the cropping system are now definitely influencing crop yields. The highest wheat yield following corn was from a rotation receiving manure. In fact, this yield was higher than that on ordinary fallow. Alfalfa in the rotation definitely increased wheat yields as did sweet clover growing with the wheat. The highest wheat yield for all treatments during this period was from sweet clover plowed under as green manure. No benefit was noted on wheat yields where grass was included in the rotation or where winter rye was plowed under for green manure.

Corn yields were definitely benefited by alfalfa or manure in the rotation and to a lesser extent by grass or sweet clover during the period from 1947 to 1953. As was pointed out earlier, corn yields during the first four-year period were highest from continuous or alternate corn and fallow. It will be noted that during the last period, yields from these treatments are by far the lowest.

Average yields of wheat and corn from cropping systems with and without legumes and manure applications at Mandan, N. D., 1915-53, 1915-18, and 1947-53

Previous crop	Management practice	Average yield per acre		
		1915 to 1943[1]	1915 to 1918	1947 to 1953[2]
	WHEAT	*Bushels*	*Bushels*	*Bushels*
Corn	None	15.9	20.6	17.5
Corn	Alfalfa in the rotation	19.4	22.7	24.5
Corn	Grass in the rotation	15.9	17.8	17.0
Corn	Sweet clover grown with wheat	15.9	21.7	21.7
Corn	Manure applied in the rotation.	19.1	20.8	26.1
Fallow	None	21.5	26.6	25.4
Fallow	Manure applied	24.3	30.3	28.4
Sweet clover	Plowed under for green manure	19.9	22.6	28.8
Winter rye	Plowed under for green manure	19.3	23.6	24.0
	CORN			
Small grains	None	26.8	31.9	32.8
Small grains	Alfalfa in the rotation	[3] 26.7	30.8	40.2
Small grains	Grass in the rotation	[3] 26.1	24.2	36.0
Small grains	Sweet clover in the rotation	27.4	29.9	36.1
Small grains	Manure applied in the rotation.	27.8	29.9	38.0
Corn (continuous)	None	26.6	35.4	22.2
Fallow	None	28.4	33.8	25.2

[1] Thirty-six year average. Three years omitted because of hail damage.
[2] Four year average. Three years omitted because of hail damage.
[3] Mean of 35 instead of 36 years.

South Dakota

PROTEIN CONTENT OF CORN, BARLEY INCREASED BY FERTILIZER N

Lawrence O. Fine, Brookings.--Crude protein content of corn grain was influenced by fertilizer application and by the preceding crop (see following table). The first increment of nitrogen produced an increase in crude protein content of corn grain where corn followed alfalfa, but not where corn followed corn or barley. In the latter case, the first 40 pounds of nitrogen applied resulted in a yield increase from 50 bushels to 78 bushels per acre. This 28-bushel increase accounts almost exactly for the 40 pound nitrogen increment, when one considers the nitrogen content of the stover, as well as the grain.

Crude protein content of barley was increased materially by application of 40 and 60 pounds of nitrogen per acre (see following table).

When grain is fed on the farm, the value of the extra protein produced, as well as the extra crop, should be considered when one is evaluating crop rotations and fertilizer usage.

Crude protein content of corn grain associated with fertilization and cropping practices, Brookings, S. D., 1954

Fertilizer used		Crude protein in corn	
N	P_2O_5	Where corn followed alfalfa	Where corn followed barley or corn
	Pounds	*Percent*	*Percent*
0	0	10.6	9.8
40	0	11.8	9.7
80	0	12.2	10.6
120	0	11.4	12.0
80	25	12.0	11.0

Protein content of barley associated with fertilizer treatments, Brookings, S. D., 1954

Fertilizer used		Crude protein content of barley
N	P_2O_5	
	Pounds	*Percent*
0	0	10.8
40	0	12.4
60	150	13.2
0	150	10.9
0	250	10.9

South Dakota

NITROGEN INCREASES YIELDS, PROTEIN CONTENT OF CORN SILAGE, GRAIN

J. J. Bonneman and B. Baird, Newell. --During the last 5 years a total of 11 trials have been conducted at various locations on the Belle Fourche irrigation project to study the effect of commercial fertilizer and plant population on the production of corn.

One of these trials conducted during 1954 was designed to study the yields and protein contents of silage and grain with nitrogen fertilizer applied at the rates of 0, 50, 100, 200 and 400 pounds nitrogen per acre with plant populations of 15,000, 22,000 and 29,000 plants per acre. Silage and grain yields were influenced by rate of nitrogen applied and by plant population as indicated in the accompanying table.

Crude protein contents of the silage and grain were also increased materially by applications of nitrogen fertilizer. Maximum crude protein contents of 2.7 and 9.9 in the silage and grain, respectively, were obtained from an application of 400 pounds N with a plant population of 15,000 plants per acre. Minimum crude protein contents of 1.5 and 6.2 percent in the silage and grain, respectively, were obtained with a stand of 22,000 plants per acre without nitrogen fertilizer.

Corn silage and grain yields resulting from three plant population levels, nitrogen fertilizer applied at four rates and no fertilizer, Belle Fourche Irrigation Project, South Dakota, 1950-54

Nitrogen applied per acre[1]	Yields of silage[2] per acre from plant population of-			Yields of grain[3] per acre from plant population of-		
	15,000 per acre	22,000 per acre	29,000 per acre	15,000 per acre	22,000 per acre	29,000 per acre
Pounds	*Tons*	*Tons*	*Tons*	*Bushels*	*Bushels*	*Bushels*
0	10.0	9.4	9.9	52	44	39
50	12.4	12.6	13.4	70	76	74
100	12.4	15.0	16.3	74	84	85
200	13.2	15.3	17.3	72	85	93
400	14.0	14.9	15.8	73	83	74

[1] Phosphate applied to all plots at rate of 50 pounds P_2O_5 per acre
[2] On 63.7 percent moisture basis
[3] On 15.5 percent moisture basis

Wyoming

ALFALFA RESPONSE TO P_2O_5 CORRELATED WITH $NaHCO_3$-EXTRACTABLE P

William F. Spencer, Laramie.--During the past 3 years, various rates of phosphate fertilizer were applied to established stands of alfalfa. Soil samples from the experimental areas were analyzed for $NaHCO_3$-extractable phosphorus. Calculation of proportionality constants in the Mitscherlich equation indicates a high correlation between response of alfalfa to phosphate fertilization and available soil phosphorus as shown by the $NaHCO_3$ extraction procedure.

A limited number of phosphorus test correlation studies were also conducted with sugar beets and field beans. According to the data calculated by substituting the appropriate constants in the Mitscherlich equation, the soil test value which represents the theoretical point at which no response will be obtained to phosphate fertilization is 75, 54, and 45 pounds P_2O_5 per acre for sugar beets, alfalfa and field beans, respectively. This indicates that crops differ in their need for phosphate--the phosphate requirement for sugar beets, alfalfa and field beans decreasing in that order.

Wyoming

REGULATING FERTILIZER, IRRIGATION PRACTICES UPS MEADOW YIELDS

R. D. Lewis, Laramie.--Responses of meadows to fertilizer application vary with irrigation practice and vegetative composition of the meadow. Highest yields of hay for all fertilizer treatments on native meadow were produced with 80-0-0, regardless of the irrigation schedule. However, 0.7 ton more hay per acre was produced with irrigation water applied every 7 days than with continuous irrigation.

Highest yields of hay for all fertilizer treatments on alfalfa-alsike-brome was produced with 40-200-0 plus lime for continuous irrigation and with 80-0-0 when irrigation water was applied every 7 days. The yield with 80-0-0 for water applied every 7 days was 0.9 tons higher than with 40-200-0 plus lime for continuous irrigation.

Hay yields of a complex mixture were not significantly increased by any of the fertilizers applied when irrigation water was applied continuously. Where the water was applied every 7 days, the highest yield was produced with 80-200-0 plus lime although that yield was only slightly greater than the yield where 80-0-0 was applied.

Vegetative composition was influenced by fertilizer and irrigation practice. There were more grasses and legumes and less sedges and rushes in native meadow irrigated at 7-day intervals, compared with continuous irrigation. There were more grasses and less legumes, sedges and rushes in alfalfa-alsike-brome where the complex mixture was irrigated at 7-day intervals than where it had continuous irrigation. There were more sedges and rushes and less grasses and legumes in native meadow, with and without fertilizer, compared with alfalfa-alsike-brome and complex mixture. There was a lower percentage of grasses, sedges, and rushes and a higher percentage of legumes where the fertilizer treatments were 0-0-0 and 0-200-0 plus lime compared with the other fertilizer treatments.

SOIL STRUCTURE

Alabama

COMPACTED LAYERS ARE NOT UNCOMMON IN ALABAMA SOILS

V. C. Jamison, Auburn. --Information gained to-date from a survey of the extent and seriousness of soil compaction in Alabama indicates that compacted layers are fairly common, particularly in the zone just below the plow depth in medium to coarse textured soils. Layers sufficiently compact to cause undesirable effects on plant growth have been found in soils of the Red bay, Greenville, Orangeburg, Ruston, Norfolk, Cahaba, and Kalmia series.

Intensive root distribution studies at one location where compaction was severe showed that root restriction may be due in some cases to mechanical resistance to root penetration, but suggested that poor aeration in the dense layer during wet periods may often be more important in preventing root penetration. Shallow rooting of cotton in Greenville and Red Bay soils with compacted layers at 5-10 inches was much more pronounced in years when wet periods occurred during the stage of most rapid plant growth. On the other hand, root restriction in the sandier Cahaba soil appeared to be greatest in dry years and to be due to low moisture supply and rapid hardening of the compacted layer in dry weather.

A severe traffic pan was found at about 5 to 7 inches in both the Ruston and Orangeburg soils on the old SCS nursery at Thorsby. This pan varied in bulk density from spot to spot but the mean of a large number of determinations was 1.9 grams per cc.

Missouri

SUBSOILING HAS NOT PROVED PRACTICAL ON CLAYPAN SOIL

D. D. Smith, Columbia. --When the surface soil was adequately fertilized, subsoiling did not materially affect crop yields on Mexico silt loam, a claypan soil at the Midwest Claypan Experiment Farm, McCredie, Missouri. When lime or lime and rock phosphate were added to the 9 to 18 inch soil horizon, during the subsoiling operation, yields of corn, soybeans and legumes were only slightly higher and runoff slightly less during the period 1948-54. Yield data from the study are given in the table that follows.

In these studies, subsoiling was done to a depth of 16 to 18 inches on an 18-inch spacing when the soil was sufficiently dry to shatter. A uniform high level soil fertility treatment was applied to the surface 9-inch layer. This included lime, phosphorus and potassium. Starter fertilizer was used on all crops and extra nitrogen was applied to

Yields of crops after subsoiling with and without deep placement of lime or lime and rock phosphate, McCredie, Mo., 1948-54

Crop	Period	Yield per acre		
		Without subsoiling	Subsoilded	Subsoiled and deeply fertilized
		Bushels	*Bushels*	*Bushels*
Corn.....	1948-53 1941 excluded	101	98	[1] 105
Soybeans.....	1948-53	30	30	[1] 32
Wheat.....	1948-53	31	27	[1] 31
Corn.....	1951-54	51	--	[2] 56
Wheat & Oats.....	1951-54	36	--	[2] 37
		Tons	*Tons*	*Tons*
Alfalfa & Brome.....	1948-49	3.4	3.9	[3] 4.3

[1] Deep treatment: 2 tons lime in 1941, 4 tons lime and 1 ton rock phosphate in 1947.
[2] Deep treatment: 4 tons lime in 1949.
[3] Deep treatment: 1 ton lime, 500 pounds 0-20-20 in 1945.

corn and wheat. The deep treatment included 4 tons per acre and rock phosphate at one ton per acre. Nitrogen was not placed in the subsoil zone on any of the treatments until 1954. Downward movement of nitrates with water percolation was assumed. In the drought year of 1954 when there was no percolation below the plow depth after corn planting, nitrogen placed 16 inches deep resulted in a significant increase in forage yield.

Measurements from terraced field areas in a corn-small grain-sweetclover rotation have shown that deep treatment has reduced annual runoff 11 percent (equivalent to 0.5 inch). Practically all of this reduction was measured during the sweetclover period and was undoubtedly the result of a higher evapotranspiration rate due to the superior growth of sweetclover on the deep treatments.

In earlier experiments, when surface fertilization consisted of lime and a starter fertilizer without nitrogen on the small grain of the rotation, corn yields were increased by as much as 50 percent by a deep treatment of lime, but the average annual yield was only 33 bushels per acre, or about one-third that with full fertility treatment applied to the surface 9 inches.

These results strongly indicate that for the present the practical approach to deepening the root zone on claypan soils for high yields is to apply full treatment to the surface 9 to 10 inches. This may be done on cultivated land by plowing in the normal operations for seed bed preparation. On pasture or sod land that the farm operator does not wish to plow, fertilization throughout this depth can be accomplished by special equipment now available.

Kansas

CRUST STRENGTH OF MOIST SOILS DECREASES WITH MOISTURE INCREASE

F. C. Thorp and R. J. Hanks, Manhattan.--The effect of bulk density and moisture content on soil crust strength has been determined for Albion fine sandy loam, Keith silt loam, and Munjor silty clay loam.

At a given compaction, the crust strength of the moist soils, in general, decreased as the moisture content increased. This decrease was greater for the Albion fine sandy loam and Munjor silty clay loam than for the Keith silt loam. At a given compaction, the crust strength of the soils dried at 50°C. increased markedly as the moisture content of compaction increased. The crust strength increased as compaction increased under all conditions.

Nebraska

ONLY SMALL PHYSICAL DIFFERENCES DUE TO PLOWING, STUBBLE MULCH

F. L. Duley and Melvin K. McCarty, Lincoln.--Studies were completed by Melvin K. McCarty on "Some effects of stubble mulch tillage on the physical condition of the soil". Experience has shown that under certain conditions, crop yields with stubble mulch tillage may be slightly below those on plowed land. Many determinations have been made of the nitrate content of soil under these two types of tillage. These determinations show that the stubble mulched land is usually slightly lower in nitrate than plowed land. There was some question, however, that some physical factors altered by subtillage may have some effect.

Determinations were made of volume weight, total porosity, aeration porosity, dry aggregate analysis and relative compactness. These determinations showed only slight to no difference as affected by the tillage treatments. The analysis of oxygen content of the soils also showed a slight but non-significant higher content in the plowed land. The results of this study indicates that the important physical properties of the soil are not materially altered by stubble mulching as compared with plowing. Thus, differences in yields on land tilled in the two ways seem to be due to other causes. However, further research on the problem is needed.

South Dakota

SOIL CONDITIONERS AT TIMES INCREASE EMERGENCE OF BEET SEEDLINGS

Joseph J. Bonnemann, Newell.--In 1952 and 1953 the value of soil additives for controlling crusting and increasing the emergence of sugar beets was determined for several trials conducted on the clay soils of the Belle Fourche irrigation project. The primary purpose of most of these trials was to study the effect of the additive on crop production, not on emergence alone. When weather conditions favorable for emergence prevail, there seems to be little or no advantage in the use of the additive. Under adverse weather conditions, the emergence has been increased as much as 50 percent.

In some of the 11 trials conducted in 1954, it was possible to observe the effect of the additive on the soil surface but there was no increase in emergence attributed to additive treatment.

Although significant differences were not obtained, in seven out of ten trials the additive "IBMA" applied at the two highest rates gave greater total emergence of beet seedlings than the other treatments. Also, in seven out of ten trials the poorest of the additive treatments, regardless of type of additive used, had a greater total emergence of beet seedlings than the check treatments.

Texas

ERODIBLE AGGREGATES INCREASE UNDER GRASS

C. E. Van Doren, Bushland.--Crop rotations. During the winter of 1955, samples were taken of the surface inch of soil on the crop rotation plots at three different dates for dry sieve aggregation studies. These data were summarized on the basis of aggre-

gates less than 0.84 mm. in size, which was the size of soil aggregate found by Zingg and Chepil to be the dividing point in determining erodibility of the fine-textured soils in this area.

Similar studies were made during the winter of 1954. Results of the samples in 1954 and 1955 were very similar with the exception of the plots plowed out of grass in 1954 and the plots seeded to grass in 1953. The percent of aggregates less than 0.84 mm. after the first year in cultivation following grass were lower than in the other treatments. This same set of plots after being plowed out of grass in the winter of 1954 showed 67.2 percent aggregates less than 0.84 mm. in size. After one year of cultivation the percentage of soil aggregates less than 0.84 mm. completely reversed. The plots seeded to grass in 1953 have shown a steady increase in aggregates less than 0.84 mm. in size, from 43.5 percent on January 19, 1954 to 64.6 percent on March 24, 1955.

These data show that erodible aggregates in the surface inch of soil increase a considerable amount while the land is in grass and decrease a great deal within a relatively short period of time when returned to cultivation.

The amount of surface residue on the crop rotation plots varies from 0 on the wheat-following-fallow plots to 3,790 pounds on the fallow-after-wheat plots. Although the amount of surface cover varies a great deal, there has been no wind erosion on this series of plots so far this year.

Stubble mulch plots. The results show a gradual breakdown and increase of soil aggregates less than 0.84 mm. in size from December to March. The highest percentage from the March sampling was on delayed fallow and the lowest on continuous wheat with the oneway disc plow. The results are very similar to those obtained during the winter of 1954. It seems that in the fall, after the land has been plowed and cultivated, the percentage of soil aggregates greater than 0.84 mm. has increased and during the winter this clod structure breaks down. During the two years this study has been made, the percentage of soil aggregates less than 0.84 in size has been about the same at the start of both winter seasons and increased about the same amounts by the close of both winter seasons.

The amount of surface residue on these plots varies from 0 to 3,790 pounds per acre. The greatest amount of residue is on the plots fallowed following the 1954 wheat harvest. The wheat-on-fallow-plots have no measurable amount of residue due to a wheat failure in 1953. There has been no wind erosion on any of the stubble mulch plots so far this year.

DRAINAGE

Virginia

LAND GRADING MAY REDUCE NEED FOR QUARTER DRAINS

J. Phelps Walker, Blacksburg.--Coastal plain soils such as Elkton vfsl or Bladen vfsl have very low infiltration and very low permeability throughout the profile. Bedded rows laid out parallel to the field drainage ditches must be drained to these ditches by frequently spaced "quarter drains" that will carry the water across the rows to the ditch. These quarter drains require hand labor for construction and maintenance and often interfere with cultivation and harvesting operations.

In the spring of 1954 studies were initiated southeast of Norfolk to determine methods of land grading that would reduce the number of quarter drains required. Maximum use of the existing row channels was proposed. For comparison row lengths between quarter drains varied in 100' increments from 100' to 600'. Plot widths were 50 feet. Two replicates were crowned or turtle backed to the middle and also given a

longitudinal grading parallel to the rows. Four replicates received only the longitudinal grading. Plots representing each of the row lengths were separated by a diversion terrace type of quarter drain.

During 1954 the entire area was planted to soybeans. Precipitation, June to October, was 21.14 inches, of which 17" fell in July and August. No water was observed ponded on test areas 12 hours after the end of a storm.

A significant difference in yields was found between each of the three major areas, designated as Block I, II, and III in the table that follows. The farm owner noted that previous yields were consistently the highest in Block II and the lowest in Block III. This year he reported that Block I was very compact, although it dried to cultivating moisture two days earlier than the other two blocks. The significantly lower yield from Block I may be attributable, at least in part, to the large amount of soil manipulation required for turtlebacking.

Soybean yields associated with drainage achieved with two types of grading and six lengths of row between quarter drains, St. Brides, Va., 1954

Plot Lengths	Yield per acre		
	Block I* (Turtleback & longitudinal)	Block II* (Longitudinal)	Block III* (Longitudinal)
Feet	*Bushels*	*Bushels*	*Bushels*
100	25.0	31.2	25.4
200	22.8	29.1	27.4
300	24.8	29.2	28.2
400	26.5	31.6	26.6
500	25.1	30.3	25.6
600	24.2	30.5	28.2
Average for block	24.7	30.3	26.9

*Acreages in blocks: I--5.3; II--5.8; III--4.9.
Machine hours of surface preparation (plowing, discing, tilling, grading, seedbed preparation): I--110 (including approximately 62 devoted to plowing and scooping for turtlebacking); II--44; III--23.

North Carolina

USE OF LAND LEVELER AIDS IN DRAINAGE AND IMPROVES CROP STANDS

E. G. Diseker, Raleigh.--Depressions, which range in size from 10 to several hundred feet in diameter and from one inch to several feet deep, occur in the organic soils along the Atlantic Seaboard. These depressions cause a great deal of trouble from the standpoint of drainage, land preparation, planting, tillage, and harvesting, and loss of stand frequently results when water accumulates.

It was previously believed impractical to use leveling equipment on the organic soils because of the trash conditions prevailing. However, studies conducted at the Open Grounds Farm near Beaufort, N. C., using a medium-size Eversman land leveler, has indicated considerable promise for land leveling. Plots were laid out on land having depressions ranging from one inch to 12 inches in depth and up to 30 inches in diameter, and containing a great amount of trash with roots and limbs up to 4 inches in diameter. Two months before leveling, plots in one series were tilled once and those

in another series were tilled twice with a Seaman rotor-tiller. Also, the tiller was used on some plots again just before leveling. Results showed that where the tiller was used two months prior to leveling and not later, results were only fair regardless of whether the land was gone over once or twice with the leveler. On the other hand, where the tiller was used one time two months before leveling and again just prior to leveling, results were very good.

Use of the tiller just before leveling resulted in much less trash interference. Also, the soil was loose and easier to spread. While there was some advantage in contour from operating the leveler a second time over, the difference between once over and twice over was so slight that the second operation was deemed inadvisable. Large limbs and roots gave more trouble during the second leveling and there were a great number of small furrows left in the soil as a result.

Following the leveling, small ponds of water no longer collected, and stands vetch and oats were improved about 35 percent. The leveled areas permit more efficient use of modern farm machinery.

Florida

HERBICIDES CONTROL VEGETATION ALONG DITCHES IN SOUTH FLORIDA

M. H. Gallatin, James E. Browning, John Noonan, Homestead. --The control of plant growth in and along drainage ditches has become a serious and costly problem in South Florida. Tests with herbicides were set up in March 1954 on the ditches of the Highlands Water Control Plot and also on three sections of ditches in cooperation with B. and L. Farms.

In the table attached are given the materials used, along with a rating as to effectiveness of control of the various plants. Note that most of the materials which killed quickly did not give long time control. Neither did mixing of materials which kill by searing (such as Octone and Penite 6) with materials that must be absorbed (such as Amizol and Dalapon) give effective, long time control.

Aqua San was used for the control of aquatic growth such as Chara (Charophyceao), and pondweed (Potamogeton). The Aqua San was applied at full concentration calculated on ditch area to give a concentration in the water of at least 200 P.P.M. The material was applied under 35 to 45 pounds pressure, with nozzles held stationary four to six inches below the surface in flowing water, and with a boom or a float boom in standing water. The material was applied in the ditches in November 1954 and allowed to remain in contact with the plant growth two days before the pumps were started. After the water level had been lowered in the ditches, it was found that practically all of the aquatic growth had been killed. A re-check of the ditches in February 1955 showed a percentage control of 92% to 95%. Spot spraying of the few remaining plants should give complete control of this growth.

A test was set up to see if herbicides would kill Woman's Tongue (Albizzia Lebbek), a type of tree that is very hardy and suckers profusely, if applied by the girdling or frilling method. Materials used were Penite 6, at one pint and two pints per gallon, plus Ammate at 1, 2, 3, and 4 pounds per gallon, and sufficient spreaders to produce a slight foam. The trees, 8 to 10 inches in diameter, were girdled or frilled about twelve inches above ground. The application was started from a foot above the frill. The chemical was applied from a gallon bottle with an applicator tube and was allowed to run down the tree trunk into the chopped area. Ammate crystals were also applied to one series of the frilled trees, and both Ammate and Penite 6 were applied to young sapling growth without frilling.

Effect of different herbicides and herbicide mixtures on control of ditch-bank vegetation in South Florida, 1954

Herbicide treatment	Brush		Willow		Cattail		Colocasia		Grasses	
	Effect after:		Effect after:		Effect after:		Effect after:		Effect after:	
	1 wk.	9 mo.	1 wk.	9 mo.	1 wk.	9 mo.	1 wk.	9 mo.	1 wk.	9 mo.
245T (ACPC 977), 6 qts. Diesel Oil, 10 gal., Dalapon 10 #, Water 90 gal.	E	E	E	E	E	E	N	N	E	G
Amizol 10# and 100 gals. water	S	E	S	E	S	E	S	G	S	G
TCA 75#, Ammate 300# and 300 gals. water	E	G	E	G	N	N	N	N	G	P
Octone, 2 qts. and 30 gals. Diesel Oil	-	-	-	-	-	-	-	-	-	-
245T (Dow Esterol) 2 gals., Diesel Oil, 10 gals., 90 gals. water	-	-	-	-	E	E	-	-	E	G
245T (ACPC 977) 1 1/2 gal., Diesel oil, 10 gal., 90 gals. water	-	-	-	-	E	E	-	-	E	G
Ammate, 150#, 24D (Dow),2qts., 100 gal. water.	E	F	-	-	-	-	-	-	E	G
Ammate 300#, CMU 40#, 300 gals. water	E	E	E	E	-	-	-	-	E	G
Penite 6, 4 gals., and 100 gals. water	E	F	E	F	E	P	-	-	E	F
Ammate, 150#, Penite 6, 1 gal. and 100 gals. water	E	F	E	F	E	P	-	-	E	P
245T (Dow Esterol) 2 gals., Diesel oil, 5 gals. and 95 gals. water	E	E	E	G	E	F	-	-	E	G
Ammate 50#, 24D (Dow) 3 qts., TCA 15#, 100 gals. water	E	F	E	F	E	N	-	-	E	F
Ammate 50#, 245T (ACPC 977) qt., 24D, 1 qt. (Dow)	E	G	E	G	-	-	-	-	G	G
245T-24D (ACPC # 32) 2 gals., VL 600, 2 gals., (Goodrich), 100 gals. water	E	E	E	E	E	E	-	-	E	G
Amizol 2 1/2#, 245T (Dow Esterol), 2 qts., 25 gals. water	-	-	-	-	-	-	S	G	S	G
Amizol 2 1/2# and 25 gals. water	-	-	-	-	-	-	S	F	S	F
Amizol 10# and 100 gals. water	S	G	S	G	S	E	-	-	S	G
Amizol 10#, 245T (ACPC Propionic), 2 gals., and 100 gals. water	G	E	G	E	G	E	-	-	S	G
Amizol 10#, Dalapon 5# and 100 gals. water	S	E	S	E	S	G	-	-	S	E
Dalapon 25# and 100 gals. water	-	-	-	-	-	-	N	N	S	E
Dalapon 50# and 100 gals. water	-	-	-	-	-	-	N	N	S	E
Dalapon 75# and 100 gals. water	-	-	-	-	-	-	N	N	S	E

E - Excellent control
G - Good control
F - Fair control
- - No trial
P - Poor control
N - No control
S - Slow acting

Leaves on all Penite-treated trees began drying up within a week or ten days after treatment, and no re-growth occurred either on frilled trees or on the young saplings without frilling. On the trees treated with Ammate, the leaves first turned a light yellow color and then dried and dropped. However, in all treatments re-growth began to appear again in four to six weeks. As this treatment with Ammate did not seem effective, the Ammate-treated trees were re-treated with Penite 6, at the rate of 1, 2, 3, and 4 pints diluted to one gallon. These applications were applied two months after the treatment with Ammate. The trees lost their foliage, no re-growth or suckering has occurred in any of these trees, and the wood has been slowly disintegrating. About six months after the original application, the smaller trees could be pushed over by hand. Lower rates of Penite killed more rapidly than higher rates.

From these trials, we find this method of killing to be a good, economical method of control. While Ammate has given good results in other areas, it was not effective in our trials.

Minnesota

PRELIMINARY: 90 DEGREE ANGLE O. K. FOR LATERALS, MAINS OF SAME SIZE

Charles A. Donnelly, Fred W. Blaisdell, Phil Manson, St. Anthony Falls Hydraulic Laboratory, Minneapolis. --It has been common practice in many areas to bring drain tile laterals into the main at angles of less than 90° on the supposition that this was required to give adequate hydraulic characteristics at the point of junction. The practice is costly and introduces chances for structural failure due to the cutting and fitting of tile to complete the angled approach and junction.

Using a recirculating model system equipped with a panel of manometers for checking head variations at all critical points, initial studies have been made where the lateral and the main were of equal diameter. The angles of entry tested to date are 90°, 75° and 45°. The results thus far obtained indicate that the changes in loss at the junction achieved by reducing the intersection angle is so small that it can be safely neglected under the usual field conditions. The loss at junctions where most of the flow is from the lateral is considerably reduced by the flatter angle of intersection. Usually, however, only a small proportion of the flow is from the lateral, and in that case the reduction in the loss of head due to the flatter angle of intersection would probably be unimportant from a practical standpoint.

Future studies will test characteristics of other junction variables including effect of overfalls and various flow proportions.

CROPPING SYSTEMS

Georgia

THREE-YEAR CROPPING SYSTEM GIVES INADEQUATE SOIL PROTECTION

G. N. Sparrow, R. L. Carter, A. W. White, Jr., Tifton. --A three-year cropping system, originally considered adequate for surface protection of three percent slopes in the Middle Coastal Plain, was found inadequate during the period from 1952 through 1954. The three-year system included Spanish peanuts followed by blue lupine, corn followed by oats for grain, and the oats followed by blue lupine. Its measure of adequacy was gauged by comparison with continuous peanuts, which has long been considered as one of the most damaging systems of cropping in the Southeast, and with a Bermuda grass and a corn sequence. Results of the comparisons are shown in the table that follows.

Average annual soil and water losses under various cropping systems, Tifton, Ga., 1952-54

Cropping system	Soil loss per acre	Water loss
	Tons	*Inches*
Spanish peanuts (blue lupine); Hybrid corn (Oats for grain); Oats for grain (blue lupine).....	0.97	1.75
Spanish peanuts (winter fallow).....	0.87	2.26
Coastal Bermuda grass (Crimson clover)..	0.19	0.11
Hybrid corn (crop residue over winter)..	0.57	0.69

The management of the three-year system involved land preparation and surface disturbance for lupine and oats in the fall and for row crops in the spring. Observations indicate that the weakness of the cropping system may lie more in the soil management than in the actual crops involved.

The 1952-1954 period undoubtedly is too short for sound conclusions. The average annual rainfall for the three years was 43.80 inches, against a mean expected rainfall of 48.62 inches. Intensities in 1952 and 1953 were comparable, but 1954 was an extremely dry year with storm intensities and amounts relatively low. Peanut yields were higher in the rotation system than with continuous peanuts.

Wisconsin

CROPPING SYSTEMS AFFECT PROTEIN CONTENT OF CORN AND OATS

Clyde E. Bay, Madison.--Protein analyses were made of corn and oats to determine the effect of six basic rotations on the quality of these crops. The results of the analyses are presented below.

Protein content of grain produced in various rotations, Madison, Wis., 1954

Crop analyzed	Rotation						
	COH[1]	COHHH[2]	COHH[3]	COHHHH[2]	O$\underline{O}$HH[3]	$\underline{O}$OHH[3]	WOHH[3]
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Oats.....	12.72	12.76	13.20	--	13.37	13.56	14.29
Corn.....	9.20	9.37	9.87	10.33	--	--	--

[1] Red clover, timothy, ladino hay
[2] Alfalfa, brome, ladino hay
[3] Alfalfa, timothy, ladino hay

The highest protein content of oats was found in the cornless rotations and the highest protein content of corn was found in the six-year rotation where corn followed four years of alfalfa-bromegrass hay. The only sources of nitrogen available to the crops

were the legume hay plowed under and the 5 tons per acre of barnyard manure applied at the time of seedbed preparation for the first crop following hay.

Since corn requires more nitrogen than small grain, there is not as much carry-over of nitrogen for oats following corn as for oats following wheat or oats. Thus, there is a greater supply of available nitrogen for oats in the cornless rotations with resulting higher protein content in the oats crops.

Iowa

FORAGE ESTABLISHMENT IN WIDE ROW CORN UNSATISFACTORY IN RECENT YEARS

W. E. Larson, Ames.--Farmers look at the practice of establishing forages in corn from two viewpoints. Some regard the practice as a way to eliminate the oat crop and still get a forage seeding for hay or pasture. Others see the practice as a way to grow a green manure crop and reduce erosion, and thereby increase the number of years of corn in the rotation.

Experiments in Iowa during the past 3 years were designed to determine how much corn yields are reduced by widening corn rows, and whether forages can be established in wide-spaced corn rows. Results are summarized in the table that follows.

Corn yields from two row spacings, Ames, Iowa, 1953* and 1954**

Row width	1953		1954	
	Plants per acre	Yield per acre	Plants per acre	Yield per acre
Inches	*Numbers*	*Bushels*	*Numbers*	*Bushels*
40	14,180	94.0	12,480	114.6
80	10,006	73.0	8,678	80.2

*Average of 6 experiments in 1953.
**One experiment in 1954.

Note that approximately three-fourths as much corn was grown in 80-inch rows. In two other 1954 experiments, located in the extreme drouth area of southern Iowa, corn yields were actually better from 80-inch rows than from 40-inch rows. Presumably this was due to lower plant populations in the 80-inch rows.

In general, an alfalfa-bromegrass or alfalfa-red clover-timothy forage mixture was seeded in the corn rows after the last cultivation in June.

Emergence of the seedlings was considered good in seven of nine experiments. The hot, dry weather during the latter part of the summer and fall was damaging, and seedings in 80-inch rows were considered good in only three experiments. Two were judged as fair. In no experiment was the forage stand in 40-inch corn rows considered better than fair, and none was good enough to leave for hay or pasture. Growth of the forage in 80-inch rows was always better than in 40-inch rows.

Earlier work in Iowa indicated that an August 15 seeding of forages in 40-inch corn rows was promising. However, fall seedings made during the past 3 years have not been successful.

While establishment of small seeded forages has not been satisfactory during the past few years, it is significant that all experiments except one were conducted under below-normal rainfall conditions. Several experiments were in areas with severe drouth

conditions. Thus, the experiments conducted so far may not be a good indication of what can be expected in other years.

Experience from these experiments has led to a number of suggestions for farmers planning wide row seedings even though it is not known what row width is most desirable. It is clear that increasing the space between corn rows increases the chance of establishing forage seedings. At least 80 inches between rows is necessary for operation of a small tractor between the rows. This is important since it is frequently desirable to mow weeds between the rows. In addition, if spring seedings fail, it is then possible to prepare a seedbed for a fall seeding.

Control of weeds is facilitated by use of a corn planter equipped with furrow openers; soil can be thrown into the corn to cover weeds without ridging the rows. Ridging should be avoided if hay is to be harvested the following year. Corn populations should probably be about 10,000 to 12,000 plants per acre in 80-inch rows.

It appears that chances of obtaining forage stands are best when plantings are made early. Possibly only one or two cultivations should be made, and then seedings made in early June. Experience has indicated that a small roller or packer should follow seeding. Cultivation without packing leaves the soil loose and encourages poor and spotty stands.

TILLAGE AND CULTURAL PRACTICES

Idaho

METHOD OF PLOWING SWEET CLOVER INFLUENCES KILL AND SURFACE RESIDUE

F. H. Siddoway, St. Anthony. --Initial kill of a sweet clover green manure crop was influenced differentially by 6 methods of plowing on June 17, 1953. Sweet clover counts were made for methods of plowing just prior to the first rod weeding operation July 15, 1953. These counts by number of plants surviving per acre are given in the table below.

Sweet clover survival following plowing treatment, comparison of 6 treatments

Plowing treatment	No. of plants per acre surviving the plowing operation
Moldboard	540
Disk before sweep	600
Disk after sweep	0
One way disk	1,500
Clip before sweep	0
Sweep	0

Sweet clover survival, as usual, was highest for one way disk plowing. This implement does not sever all of the tap roots and some plants manage to pass between the disks relatively undistrubed. When the plow-layer is dry, as it was in the spring of 1953, sweep plowing resulted in the best sweet clover kill.

Sweet clover residue samples were taken on these same plots August 10, 1953, to determine the relative quantity of residue remaining on the surface for erosion control the following winter. The residue data are summarized in the following table.

Quantity of residue remaining on surface after plowing treatments, comparison of 6 treatments

Plowing treatment	Residue per acre remaining on surface	Portion of total amount plowed
	Pounds	*Percent*
Moldboard	122	14
Disk before sweep	348	39
Disk after sweep	318	35
One way disk	275	31
Clip before sweep	508	56
Sweep	585	65
Least significant difference:		
At 5% level	116	13
At 1% level	160	18

Disking and use of the sweep resulted in significantly more surface residues than moldboard plowing. Any tillage in addition to plowing, such as disking or clipping, reduced the amount of surface residues.

Oregon

EARLY SPRING PLOWING AND DEEP PLOWING FAVOR WHEAT YIELDS

M. M. Oveson, Pendleton. --When the Pendleton Branch Experiment Station was started in 1929 a date and depth of plowing experiment was set up to include four dates and two depths of plowing. Also included were two methods of handling the summerfallow following plowing.

The yield data reported are for the 17-year period 1938 to 1954, inclusive. During this period early spring plowing (March 15) has given the highest average yield with 39.4 bushels per acre, with 2.2 bushels reduction in yield with each subsequent date of plowing. There was one month delay between each of the three dates of spring plowing. When the land was fall plowed, the average yield was more nearly that of the early spring plowing.

On each of the dates of plowing, part of the plots were plowed 8 inches deep and part were plowed 5 inches deep. Plowing 8 inches has given consistently higher yields than plowing 5 inches.

In comparing methods for working the fallow following plowing, there has been no yield advantage when the fallow was worked immediately after plowing as compared to delaying the first fallow operation for 30 days. The latter leaves the surface more cloddy and therefore offers some protection from erosion. The rougher soil surface is less conducive to weed growth and, therefore, in most seasons will require fewer tillage operations (at least one and sometimes two fewer) to keep weed growth in check.

Soil moisture and available soil nitrogen determinations made on several plots in this experiment showed a significant difference in soil nitrates at the end of the fallow season in favor of the early spring plowing over the late spring plowing. There was also a significant difference in soil nitrates in the clean tilled plots over minimum tilled plots. There was no significant differences between any of the plowing or tillage treatments with respect to amounts of available soil moisture in the early spring of the crop year.

Wheat yields associated with various plowing and cultivation methods, 1938-54 (17-year) averages, Pendleton, Ore.

Treatment	Yield per acre
	Bushels
Dates of plowing	
a. Fall-October 15	38.6
b. Early spring-March 15	39.4
c. Medium early spring-April 15	37.2
d. Late spring-May 15	35.0
Plowing depths	
a. Deep plowing (8 inches deep)	38.2
b. Shallow plowing (5 inches deep)	36.7
Methods of working fallow	
a. Immediate cultivation	37.3
b. Delayed cultivation (30 days after plowing)	36.9

SOIL AND WATER MANAGEMENT--GENERAL

Florida

PEPPERS LIKE HIGH WATER TABLE TO START, LOWER LATER

J. C. Stephens, Fort Lauderdale. --Yields and water consumption of sweet pepper plants in the soil moisture or lysimeter tanks up to March 30 are tabulated. These tanks are approximately 1/1,000 of an acre in area. Tanks 1 through 6 (Series #1) were planted to two crops of beans last winter and spring, followed by a summer crop of sorghum. Tanks 7 through 12 (Series #2) were installed this past fall, and this was the initial crop.

Yields were low in the six tanks where peppers follow sorghum. There is no noticeable difference in yield between bedded versus flat cultivation; however, from a practical standpoint bedding is preferable in the mineral soils of south Florida. The peppers do not appear to be as sensitive to different moisture ranges as the bush beans grown last year. The beans yielded the best crop with the water table at a depth of 24 inches. In the early stages of growth, the pepper plants did best with high water tables--12 inches; however, as the plants matured, the lower water table plots--24 inches--gave best results. This suggests the advantage of starting with a 12-inch water table and gradually lowering it as the plants develop. The highest quality produce is now coming from the 24-inch-depth tanks.

In these studies, the total water consumption measured includes soil evaporation and plant transpiration. Soil evaporation is mainly from the 12-inch-depth water tables. Plant size and vigor, as indicated by yields, are seen to largely govern amount of transpiration.

Submersion Tests. Tests on the sensitivity of bush beans and sweet peppers to damage by submersion were continued. Two tests were made on each type of plant under different temperature conditions in still water and in slightly circulating water. There was considerable variation in results. In general, however, higher air temperature tended to increase submersion damage and slight circulation of water mitigated injury somewhat in two of the tests. A graph was plotted of time versus injury for both beans and peppers. Although the plotted points showed scatter, the enveloping curve showed a definite breaking point between 36 and 48 hours of submersion for permanent injury to both types of plants.

Yields from sweet pepper plants grown on controlled water table plots, and typical water consumption requirements of mature plants, Fort Lauderdale, Fla., 1955

Series, tank no., and type of cultivation[1]	Average depth to water table	Soil moisture in root zone[2]	Water consumed in one week[3]	Ratio of water consumption to evaporation[4]	Total weight of produce	Relative market value of produce[5]
	Inches	*Percent*	*Inches*		*Pounds*	*Index*
1st series (following sorghum)						
1 - F	12	19.6	1.40	0.89	15.6	4.9
2 - B	12	15.4	1.33	0.85	13.1	6.1
3 - B	18	10.3	0.88	0.56	11.9	5.2
4 - F	18	11.1	0.63	0.40	6.2	1.8
5 - F	24	8.7	0.93	0.59	20.7	11.1
6 - B	24	8.9	0.95	0.61	15.4	9.3
2nd series (virgin soil)						
7 - B	12	20.4	1.64	1.04	27.6	18.8
8 - F	12	19.6	1.75	1.11	27.4	19.1
9 - F	18	13.1	1.40	0.89	28.3	19.0
10 - B	18	10.5	1.39	0.89	26.2	17.7
11 - B	24	6.2	1.27	0.81	27.2	19.2
12 - F	24	10.3	1.42	0.90	32.0	23.3

[1] F - Planted on the flat with no bedding; B - Planted on beds.
[2] Average for 0-6" soil depth.
[3] Week of March 17-23.
[4] Standard pan evaporation measurement.
[5] The relative market value of produce for each tank is the sum of the products of the weight of each grade--i.e., Fancy, #1 and #2--times its relative value at the State Farmer's Market.

Texas

WHEAT AND SORGHUM YIELDS CORRELATED WITH SEASONAL PRECIPITATION

C. E. Van Doren, Bushland.--An analysis of 12 years' data shows correlation coefficients between precipitation and crop yields in a wheat-fallow and a wheat-sorghum-fallow rotation. Precipitation was divided into combinations of annual, crop year, seasonal, preseasonal, and individual months.

Correlation between wheat yields in a wheat-fallow rotation and precipitation was similar to the correlation between continuous wheat and precipitation. Highly significant correlations are shown for seasonal precipitation October 1 to June 1, October 1 to July 1, September 1 to July 1, the months of October-November-April-May in combination, and the months of April and May together. Analysis by individual months showed the months of April and May to be significant at the 5% level. Precipitation during the fallow period showed no significance in relation to wheat yields.

Correlation coefficients between wheat yields in a wheat-sorghum-fallow rotation and precipitation showed significance for seasonal precipitation. The periods October 1 to June 1 and October 1 to July 1 were highly significant at the 1% level. The months of

April and May together, and October, November, April, and May in combination are significant at the 5% level. Precipitation from harvest of sorghum to wheat seeding the following fall shows no significance in relation to wheat yields in a wheat-sorghum-fallow rotation.

Correlation coefficients between sorghum yields in a wheat-sorghum-fallow rotation and precipitation show results similar to those from continuous sorghum. The highest correlation in relation to sorghum yields was precipitation for the months of May and June which was highly significant at the 1% level. Two other periods were also highly significant: April 1 to July 1 of the current year and July 1 of the previous year to October 1 at sorghum harvest. Precipitation from June 1 to October 1 during the growing season was not significant. Correlation coefficients for individual months showed the months of May and June to be significant at the 5% level.

The results of this analysis of wheat and sorghum yields in the wheat-fallow and wheat-sorghum-fallow rotation would indicate that very inefficient use is being made of precipitation received during a fallow period.

Texas

SUBSOIL INFLUENCES RELATIONSHIP OF RAINFALL TO COTTON, KAFIR YIELDS

W. C. Moldenhauer, Big Spring--Relationships between preseasonal and seasonal rainfall and yields of cotton and kafir were determined on Amarillo fine sandy loam with typical sandy clay loam subsoil and on Amarillo fine sandy loam with a fine-textured sandy clay subsoil. For cotton, the percentage of variability in yield accounted for by preseasonal and seasonal precipitation decreased from 71% on the soil with fine-textured subsoil to 46% on the more typical Amarillo fine sandy loam. The percentage of variability in yield of kafir accounted for by preseasonal and seasonal precipitation was 61% on the more typical Amarillo fine sandy loam as compared to 50% for milo on the soil with a sandy clay subsoil.

Preseasonal precipitation was below 5 inches during 5 of 38 years. A yield of more than 185 pounds of cotton per acre occurred once and yields more than 106 pounds per acre occurred twice during the five years with rainfall less than 5 inches. Where the preseasonal rainfall was above 5 inches, a yield less than 100 pounds of cotton per acre did not occur. Yields less than 140 pounds of cotton per acre occurred only twice during the 33 years when rainfall was greater than 5 inches.

Alignment charts have been prepared for use in predicting yields of cotton and kafir that can be expected with a given amount of preseasonal precipitation.

Texas

GERMINATION OF SEEDS AFFECTED BY ANTIBIOTIC

R. M. Smith, Temple.--Seeds of corn, cotton, and sweetclover were planted on filter paper and soil soaked with the following concentrations of actidione: 0.0 (water), 0.2, 1, 5, 10, 25, 50, 100 and 200 parts per million.

At 10 ppm cotton seeds (acid-delinted Lankart 57) appear to germinate somewhat better than with water alone; above this concentration germination was reduced. Corn seed germination was not enhanced by low concentrations of the antibiotic but concentrations above 50 ppm reduced it substantially. Actidione at 1 ppm increased germination perceptibly in sweetclover.

In soil, early germination (48 hours) of cotton seed was enhanced by concentrations ranging from 5-50 ppm; above this concentration, percentage germination was reduced. At the end of 7 days the number of surviving seedlings was no greater than in the water treatment (control) but was definitely reduced by 50 ppm and above. Concentrations from 0.2 to 10 ppm increased early germination in corn, but the effect on the number of 7-day old seedlings was only slight. The number of 72-hour old seedlings was perceptibly increased in sweetclover by 0.2 to 25 ppm of actidione.

The effect of the antibiotic (on paper and in soil) on seedling growth has been studied. Using length of sprout growth as the criterion results were as follows: Cotton seedlings were affected little below 10 ppm; above this concentration seedling growth was definitely reduced. Corn sprout growth in soil was increased markedly by 0.2 and 1 ppm and decreased visibly above 10 ppm. On paper the inhibitive effect on growth was apparent at 1 ppm. Sprout growth of sweetclover in soil was enhanced between 0.2 and 10 ppm; above this point it was definitely reduced. On filter paper only 0.2 ppm enhanced growth; above this concentration it was greatly reduced.

When oven-dry weight of individual seedlings is the criterion of growth, concentrations ranging from 5 to 200 ppm appear to stimulate growth in cotton and concentration of 0.2 to 200 ppm in corn.

To study further the effect of graded concentrations of actidione on germination and seedling growth in soil, another experiment was conducted in which seeds were planted in substrates soaked with antibiotic and the seedlings allowed to grow for 14 days. Corn seed germination and seedling growth were stimulated by 0.05 up to 1 ppm of actidione. Above this concentration they were increasingly inhibited. Cotton seeds showed enhanced germination and seedling growth was stimulated by actidione between 0.25 and 1 ppm. Germination was improved by 0.05 ppm but seedling growth was not stimulated in sweetclover.

Texas

STEERS MAKE LARGE DAILY GAINS ON OATS AND CLOVER PASTURE

R. M. Smith, Temple. --A summary of beef cattle gains since 101 Angus steer calves were put on grazing on February 7 is shown in the accompanying table. The overall average of 1.75 pounds per head daily for the 49-day period is considered good. Excellent gains averaging 2.93 pounds were obtained during the last 21 days of the period when grazing was abundant.

The best gains have been obtained on oats with clover and on barley with clover. Highest gain per acre has been on barley with clover, where the barley was drilled with a deep furrow drill, without other tillage of any kind. This land, which is sloping and erodible, was also in barley last year, following a year in sudangrass.

In field 2B there is a suggestion of value from dry hay compared to the green grazing only. This is not considered conclusive. A previous trial in 1954 failed to show any benefit from hay when the steers had plenty of grazing.

Present results emphasize the need for abundant growth if high gains are to be obtained. Some farmers in this area keep their grain and grass fields grazed down to a level that prevents them from getting much more than animal maintenance. This kind of grazing doesn't put on the weight and condition needed for profit with beef cattle.

Beef cattle* gains on various pastures, February 7 to March 28, 1955, Temple, Tex.

Field	Crop**	February 7 to March 28		March 7 to March 28, only	
		Steer gain per head per day	Steer gain per acre	Steer gain per head per day	Steer gain per acre
		Pounds	*Pounds*	*Pounds*	*Pounds*
1 - A	O (M)	2.56	81	3.75	72
1 - B	O (M)	2.18	54	3.44	54
1 - C	O (M)	1.97	48	3.04	44
1 - D	O (M)	1.90	67	2.65	56
2 - B	O (M), without hay	1.76	51	2.39	30
	with hay	2.16	63	3.10	38
3 - C	B (E)	2.40	102	3.43	77
7	Native grass			1.56	29
8 - F	KR bluestem plus clover			2.91	16
PP-S[1]	Bermudagrass	1.25	43	2.72	40
4[2]	O (H)	1.08	18		

Average weight--February 7--518 pounds per head.
Average weight--March 28--604 pounds per head.
Average daily gain per head--February 7 to March 28--1.75 pounds.
Average daily gain per head--March 7 to March 28, only--2.93 pounds.

*The cattle were wintered on hay, cottonseed meal and a small amount of hammered oats up to February 7 when grazing was started.

**O - Oats; B - Barley; (M) - Madrid sweetclover; (E) - Evergreen sweetclover; (H) - Hubam.

[1] Includes cool-season grasses and buffalograss.

[2] Grazed February 7 to March 7 only.

Texas

WINTER PEAS COVER BEFORE COTTON ADDS N BUT REDUCES SOIL MOISTURE

R. M. Smith, Temple.--On March 25 the winter cover crop of Austrian winter peas planted with a Dempster deep furrow drill in the middles between beds was torn out with a trash mulch plow equipped with 30-inch sweeps. The top growth yield amounted to 2.4 tons of green material, or 0.5 tons of dry matter per acre over the entire area. The growth was considered normal or good for the area. We have not observed any pea growth on surrounding farms that was as good. From past analyses it is estimated that the tops contained about 30 pounds of nitrogen per acre.

Soil moisture samples were taken before the peas were destroyed (see table). One factor that contributed to low moisture in the beds where peas were grown was cracks that formed down the center of the beds. This resulted from soil shrinkage as the peas withdrew moisture from both sides of the beds.

From this comparison, it appears that the question to be answered is which is the more important to the cotton crop that is to be planted: 30 pounds of nitrogen from fresh legume organic matter or one inch of water. During the past several years the water has

probably been more critical than available nitrogen, at least on the Station. Cotton yields following winter cover crops have been slightly lower, consistently, than cotton yields without a winter cover. This has been on fertile land with slopes of 1.5 percent or less. On depleted soil the nitrogen might be more deficient than water. Also, since surplus rainfall often falls during April or May, it is possible that a limited use of water by a winter cover crop will reduce runoff and be beneficial often enough to compensate for the use of water that might be needed by the row crop during a very dry season.

Soil moisture to 24 inches* on bedded land with and without a winter cover crop of Austrian winter peas

Depth (inches)	Percent moisture		
	With winter cover	No winter cover	Difference
Within beds			
0 to 6	16.8	18.5	1.7
6 to 12	22.2	27.5	5.3
12 to 18	27.0	28.8	1.8
18 to 24	27.8	30.5	2.7
Average percent			2.9
(Total difference, in inches of water--0.96)			
Between Beds			
0 to 6	18.6	20.8	2.2
6 to 12	24.0	28.8	4.8
12 to 18	27.1	30.3	3.2
18 to 24	26.6	29.8	3.2
Average percent			3.4
(Total difference, in inches of water--1.14)			

*Each value at each depth is an average of 4 replication locations.

Montana

INFILTRATION DECREASES AS INTENSITY OF GRAZING INCREASES

Frank Rauzi, Larami, Wyo.--During June 1954, water-intake measurements were conducted on the experimental summer range pastures at the United States Range and Livestock Experiment Station, Miles City, Montana. Tests were conducted on two replicates of light and heavy-use pastures. The rate of grazing on the light-use pastures since 1932 has been 38.8 acres per cow year, the rate on the heavy-use pastures has been 23.1 acres per cow year since 1932.

During the second 30-minute period of a 1-hour test the average water intake for the light-use pastures was 0.44 inches per hour. The heavy-use pastures had an average water intake rate of 0.30 inches per hour during this same period. On this basis, the water intake on the heavy-use pasture was 30 percent less than on the pastures of light use.

All standing vegetation in the test plot, including previous year's growth, was clipped at ground level and pounds per acre were calculated on the air-dry weight of this material. The quantity of vegetation harvested from the plots on the light-use pastures was 856 pounds per acre and from the heavy-use pastures was 509 pounds per acre. The plots of light-use pastures had 68% more vegetation at the time of test than did those of the heavy-use pastures. Very little mulch was found on the pastures. No explanation of this fact can be offered at this time.

Water-intake tests were conducted on two vegetation subtypes within the same soil type. These subtypes were designated as Site I and Site II. Site I was on a poorly drained area where western wheatgrass, Sandberg's bluegrass and big sagebrush were the dominant species. Site II was on a better drained area and vegetation was composed chiefly of blue grama grass and western wheatgrass, with dead and dying cactus beds present. When the data were analyzed by the analysis of variance, the differences between treatments (degrees of use) were significant at the 5% level. The difference in intake rates between sites was found to be significant at the 1 per cent level. The treatments reacted the same in influencing the rate of water intake regardless of the site.

Kansas

NEW PROBE HELPS DETERMINE DEPTH AND AMOUNT OF SOIL MOISTURE

Paul L. Brown, Hays. --The Hays station has developed a soil probe which can be used to determine soil moisture depth, quickly and easily. The depth of wet soil is related to the amount of moisture available to a crop. This probe consists of 5/8" steel ball-bearing welded on to the end of a 3 to 4-foot 1/2" rod with a T-handle. The spur-screw end of a 1/2" wood bit (1 1/2 inches in length) is welded on the steel ball and aligned with the rod. This bit enables the user to bring a sample of soil from the depth of probe penetration to the surface for examination. This is accomplished by turning the probe while applying pressure.

This probe can normally be pushed into the soil as deep as the soil is wet by applying the user's weight to the handle. The probe is stopped by a layer of dry soil. It has been found after considerable testing that the dry, finer-textured soils brought up from the depth of penetration are hard and will not ball under pressure. The dry, coarser-textured soils have a rather dry, loose appearance and feel.

In soil recently wet from the surface downward, the line between wet and dry is quite distinct. After a period of months and without further wetting the line between wet and dry soil becomes a zone rather than a line.

Under dryland conditions, the period before planting a crop is usually one of re-wetting a dry soil from the surface downward and the line between wet and dry soil is quite distinct. The probe has its greatest value in determining moisture depth before a crop is planted or before the planted crop has removed appreciable amounts of water from the surface layers. It works well with winter wheat in the spring up to the time of rapid soil moisture use. After the wheat roots dry out a layer, it becomes necessary to bore through the dry zone to check moisture at lower depths.

Measurements on Yocemento silty clay loam, Munjor silty clay loam and Hall silt loam showed a sharp drop in moisture content below the point at which the probe was stopped. The studies also show the value of the probe in determining moisture depth and in estimating the amount of available soil moisture.

The probe is easy to use under many conditions and for this reason it should prove valuable to field personnel.

New Mexico

DATA SEEM TO CONFIRM COMPUTED RELATION OF LAG TIME TO BASIN SIZE

R. B. Hickok, Albuquerque. --Studies of the limited data available from the former Mexican Springs watershed studies in New Mexico indicate that there were no general intense storms during the period of record, even over the smallest watersheds, but that such runoffs as occurred came from limited portions of the areas. Also, the ratio of time-of-rise of all hydrographs to the apparent lag time is extremely small, and the peak rate-volume ratio of the hydrographs is out of line with records for other watersheds studied. It is believed that records were obtained of only the "tops" of the hydrographs and the bulk of such runoff as occurred was absorbed by channel losses. These are limitations on our use of these data for developing flood design information. However, times of the peaks may be little affected and indicated relative lag times may be close to correct. If so, they serve to confirm the general relationship of lag time to approximately the 0.3 power of basin size, and the indication that basin size dominates lag time for arid basins over about five square miles in area.

This relationship is given further credence by data reported by the Corps of Engineers for two watersheds in West Texas, indicating that a fair estimate of the lag time of arid land basins between 5 and 700 square miles is given by the formula:

$$\text{Lag time (in hours)} = 0.5 \sqrt[3]{\text{Area (in square miles)}}$$

In Special Reports 7 and 8 it was indicated that lag times were inversely proportional to the flood peak-volume ratio, and the volume and peak were respectively proportional (on the average) to the 0.8 and 0.5 powers of the basin size. Thus, time of lag is proportional to V/P, and is indicated to be proportional to size of basin to the 0.3 power. Though there may be considerable variation in these relationships to basin size due to other influences (especially for small basins and for large ones having unusual characteristics affecting their hydrology), the general exponential relationships of peak rate, volume and lag time to basin size which have been suggested appear to be correct.

These relationships are considered to be applicable only to arid land watersheds and useful mainly for preliminary estimates. Important designs should be checked with any other specific information available for the locality and particular basin in question.

New Mexico

MAP SHOWS RANGE CONDITION AND SITE IN ALAMOGORDO CREEK WATERSHED

J. L. Gardner, State College, N. Mex. --Alamogordo Creek. A map of range condition and site is now available. It indicates that approximately 20 percent of the area is in good range condition, 60 percent fair, and 20 percent poor. The areas that are in good range condition are, in general, on the "breaks", which receive less grazing pressure.

Arizona

VEGETATION AND SOILS OF DESERT WATERSHED CORRELATED

J. L. Gardner, State College, N. Mex. --Walnut Gulch. In collaboration with Joel Fletcher, correlations between certain vegetation and soil characteristics have been made. Approximately 70 percent of this 58-square-mile area is dominated by brush, on about six square miles of which Mortonia scabrella is the major dominant; on the rest white thorn (Acacia constricta), tarbush (Flourensia cernua), and creosotebush (Larrea divaricata) are dominant in varying degrees of mixture.

Amount of shrub cover is positively correlated with depth to caliche, claypan, or bed rock in the soil. A highly significant correlation was demonstrated between (a) presence of shrubs and of the major dominants and (b) soil pH above 8, soil derived from limestone, and presence of some form of caliche. Although correlation of amount of shrub cover with presence of hard caliche was not significant, probability increased steadily as the amount of shrub cover increased.

Thirty percent of the watershed supports grassland. Presence of grassland is significantly correlated with soils derived from rhyolite and--in contrast to that of shrubs--with stony soils. (There was a highly significant correlation between dominance of shrubs and soils that were not stony.) Lack of an erosion pavement and presence of grassland were significantly correlated. Further analysis of these vegetation and soils data will be made as time permits.

HYDROLOGY--LAND USE INFLUENCES

Ohio

WATER YIELD PER ACRE DEPENDS ON SIZE OF WATERSHED--UP TO 10,000 ACRES

F. R. Dreibelbis and L. L. Harrold, Coshocton.--In areas where stream flow is largely comprised of subsurface water flow, the yield of water per acre of drainage increases as the area increases--up to about 10,000 acres (table 1). For larger watersheds, there appears to be little or no increase in water yield.

Table 1.--Minimum water yield for various frequencies and drainage areas, based on 50-year precipitation record

Drainage area	Minimum 12-month[1] water yield per acre recurrence interval of once in-				
	2 years	5 years	10 years	25 years	50 years
Acres	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
10	7.5	3.2	1.8	1.0	0.4
100	11.5	7.7	5.8	3.9	3.1
1,000	13.6	9.4	7.3	5.2	4.2
10,000	14.0	10.0	7.7	5.6	4.4

[1] Years ending September 30.

Values of minimum water yield for various periods of consecutive months observed in 17 years of runoff records are given in table 4.

Table 2.--Minimum water yield from various-sized drainage areas for various-length periods, 1938-44

Drainage area	Length of period						
	12 months	10 months	8 months	6 months	4 months	2 months	1 month
Acres	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
29.0	0.82	0.41	0.06	0.02	0	0	0
74.2	1.91	1.01	.13	.05	0	0	0
122	2.16	1.26	.35	.18	.03	.0030	.0008
349	3.12	1.28	.33	.10	.02	.0058	.0029
4,581	3.64	1.63	.37	.13	.02	.0027	.0007
17,540	3.76	2.22	.69	.29	.07	.011	.005

In planning for surface-water supplies, the minimum water yields values are often the most important quantitative water item to be considered. Table 1, for example, shows a 50-year dependable 12-month water yield of 3.1 inches from a 100-acre watershed. This 12-month period is on the basis of the water year October-September. When any consecutive 12-month period is considered, the minimum water yield from a 122-acre watershed (table 2) amounted to only 2.16 inches--about one-third less than the water-year value.

Ohio

FROST PENETRATION IN WHEAT AND MEADOW WATERSHEDS REPORTED

F. R. Dreibelbis and L. L. Harrold, Coshocton.--Frost penetrates the soils of wheat-growing watersheds about the same as fallow watersheds. Meadow furnishes more protection against frost penetration.

Surface runoff during the winter months may be influenced by frost conditions. Records of frost penetration for January, February, and March in 1955, and the average for the 1940-54 period are given in table 1.

Frost penetration of .5 inch or more into wheat fields and meadows: Number of days and maximum depths, 1955 and 1940-54 averages, by months, Coshocton, Ohio

	Number of days				Maximum frost depth			
	In Wheat		In meadow		In wheat		In meadow	
Month	1955	1940-54 average	1955	1940-54 average	1955	1940-54 average	1955	1940-54 average
					Inches	*Inches*	*Inches*	*Inches*
Jan.....	21	20	19	11	8	11	4	7
Feb.....	22	19	21	11	8	10	5	5
Mar.....	8	10	5	5	3	10.5	1	5
Total.	51	49	45	27	-	-	-	-

Michigan

PEAK RATES OF RUNOFF AND OF SOIL LOSS COME IN DIFFERENT MONTHS

George A. Crabb, Jr., East Lansing.--Average monthly totals of rainfall at East Lansing for the period 1941-1954 closely approximate the Weather Bureau's 50-year normal totals of rainfall for that location.

Compilation of average monthly totals of runoff for 1941-1954 from the three watersheds, without differentiation as to cover, shows that the months of January, February and March, while producing less precipitation than most other months of the year, produce significantly more runoff on the average than any other months or any other three months of the year.

Average totals of runoff from each of the other months of the year are less than normal evapo-transpiration of crops for a single day in the height of the growing season.

Monthly soil loss averages over the same period of time are not severe. Soil losses do not follow the same pattern as runoff losses, but reach their peak in the months of March, May, June, and October. March soil losses are, of course, primarily associated with runoff resulting from the spring thaws. May and June soil losses are associated

with the concentration of rainfall in a period characterized by freshly-tilled soil and minimum soil cover. October soil losses are associated with occasional thunder storms occurring in the fall, and are heavily influenced by only a few severe storms in the perio of record. These figures clearly illustrate the fact that soil and water losses in South-central Michigan are associated with water management practices and are generally susceptible to control in the growing season months.

Michigan

WINTER RUNOFF AFFECTED BY COVER, NOT BY RAIN INTENSITY, PATTERN

George A. Crabb, Jr., East Lansing.--A study of 957 rainstorms occurring at East Lansing in frost-free months of 1941-51 shows that 69% contributed, each, less than 0.25 inch of precipitation, the usually accepted minimum storm total for erosion studies. This 69% of the storms contributed 23% of the total rainfall for the period.

During the period of study, 382 storms (295 in the frost-free period and 87 that came when frost was absent in the usual frost period) contributed 0.25 inch, or more, storm-total each. These 382 storms were classified to show the major intensity range of the major portion of each storm in one of six classifications. Patterns showing the section of the storm associated with the highest concentration of intensities were assigned each storm (as Advanced, Intermediate, Delayed, Uniform, Interrupted, or Sporadic.) The tabulations of occurrence of these classes and patterns of rainfall and resulting runoff, by months, storm-total, and cover were statistically analyzed. Analysis showed:

(1) Neither intensity nor pattern of rainfall had a significant effect upon runoff in the winter.

(2) Cover had a significant effect upon the extent of runoff but not upon the occurrence of runoff in the frost-free season.

(3) Cover had a significant effect upon the occurrence of runoff in winter.

(4) Storm-total was a significant factor in the production of summer runoff.

(5) Storm-total did not have a significant effect upon the amount of runoff produced, save in the case of those storms having an excessive total.

(6) Pattern and class of rainfall were not as significant as storm-total in producing runoff.

(7) Because of the complex inter-relations of these factors with other factors affecting runoff, none can be accepted alone as a primary cause of runoff.

Wisconsin

LAND IN SOD SEVERAL YEARS HAS SMALL RUNOFF FROM SECOND-YEAR CORN

Neal E. Minshall, Madison.--The storm of June 21, 1954 at Fennimore produced the least runoff from the 22.8-acre watershed although this area had more corn and higher rainfall than any of the others.

The same area was in corn on this small watershed in both 1953 and 1954. The entire 22.8-acre watershed had been in hay or pasture from 1947 through 1952. A portion of the heavy sod which was plowed under in 1953 was returned to the surface in the 1954 plowing. The area had been worked over twice with a rotary hoe but never cultivated prior to this storm, and many sod chunks and much trash remained in the surface layer.

Most of the cultivated areas on the other watersheds were in a three-year rotation of corn, grain, hay. There was no evidence of erosion from second-year corn on old sod but there was heavy damage on those corn fields in the three-year rotation which had been recently cultivated. The implication is that the one year of corn in the short rotation can be more conducive to erosion and runoff than 2 years of corn following several years of good hay.

Nebraska

PASTURE FURROWS AND LIGHT GRAZING REDUCE RUNOFF

John A. Allis, Hastings.--A statistical analysis shows that pasture furrows were highly significant and that light grazing was significant in reducing total runoff.

These results were based on six years of runoff record on .7 acre pasture plots during the period of 1940-1945, inclusive. The pastures were predominantly native buffalo and blue gramma grasses on Holdredge silt loam with slopes of approximately 5 1/2 to 8%.

The furrows were spaced at one-foot, vertical intervals and varied from 12-foot to 18-foot horizontal spacing, depending on the slope. The furrows were about 6 inches wide and about 4 inches deep. The sod removed in making the furrow was placed immediately below the furrow.

The accompanying table shows the results by years.

Total annual runoff from pasture plots under different treatments, Central Great Plains Experimental Watershed, 1940-1945

Year	Rainfall	Untreated plots		Contour furrow plots	
		Heavily grazed	Lightly grazed	Heavily grazed	Lightly grazed
	Inches	*Inches*	*Inches*	*Inches*	*Inches*
		.84	.56	.03	.12
1940.....	12.96	.52	.93	.02	.16
		1.34	.66	.09	.17
1941.....	26.72	1.33	1.73	.11	.03
		1.68	.34	.12	.01
1942.....	31.96	1.55	.67	.28	.05
		1.09	.90	.08	.06
1943.....	16.15	1.68	.88	.10	.04
		1.23	.15	.29	.02
1944.....	29.70	2.20	.50	.25	.10
		1.18	.21	.25	.07
1945.....	21.17	1.51	.46	.16	.04
6-year average..	23.11	1.35	.67	.15	.07

OATS, MEADOW, NATIVE GRASSES REDUCE RUNOFF IN MARCH STORM AT WACO

R. W. Baird and J. B. Pope, Waco.--Heavy rainfall March 20-21 gave the highest runoff rates and greatest amount of runoff since May 12, 1953 in the Blacklands Experimental Watershed. The effects of conservation practices are considerable, but the quantitative effect is not well defined because of the greater than usual differences in rainfall on the various areas. Oats and meadow land were very effective in reducing runoff even from this rain of high intensity and considerable volume.

Rainfall for each month of the January-March quarter was above normal, totaling 10.51 inches at the central meteorological station. Rains of January and February gave sufficient moisture for crop growth.

Effects of specific crops and tillage. For the storm of March 20-21 native grasses were very effective in reducing runoff. Total runoff from a three-acre watershed in native grass was only .129 inches with a total rainfall of 3.39 inches. Heavily grazed Bermuda grass pasture was not particularly effective in reducing runoff with the runoff of 1.23 inches from 3.23 inches of rainfall.

Effects of combined conservation practices. The accompanying table gives the rainfall and runoff for all the areas of Government-owned land during the storm March 20-21. Runoff was quite heavy from all mixed land use areas, and the amount of runoff was quite closely proportional to the acreage of spring planted crops. The area Y-8 which has approximately 1/4 of the area in second year fescue grass had relatively high runoff. This high runoff amount came largely from the first-year fescue and the area which was in cotton last year. While there was runoff from the areas with second-year grass and from the portion of the areas where two-year fescue had been tilled preparatory for cotton planting in 1955, evidence indicates that the runoff from these two areas was much less than the average for the whole area.

Additional interpretations will be made from this series of records.

Effect of land use on soil moisture. Comparisons between comparable conservation and conventional-farmed areas in the Y and W watersheds from cotton, corn, and oat fields before the rain of March 20-21 indicated only a small difference in available moisture. The difference was only .340 of an inch in favor of the W-10 area with conventional tillage operations. After the rain of March 20-21, the Y-10 area with conservation tillage operations picked up 1.004 inches of available moisture over the W-10 area in the 36 inch profile from which samples were taken. Surface runoff occurred from both areas.

The following table summarizes the available moisture in the 36 inch profile taken from soil samples from the two areas on March 17 and March 23:

Area and treatment	Available moisture after rain of Mar. 20-21	Available moisture before rain of Mar. 20-21	Difference in available moisture after Mar. 20-21	Rainfall March 20-21
	Inches	*Inches*	*Inches*	*Inches*
Y-10 Conservation farmed Area.....	6.094	4.268	1.826	3.34
W-10 Conventional farmed Area.....	5.090	4.608	.482	2.63

Rainfall and runoff for storm of March 20-21, 1955
Blackland Experimental Watershed, Waco, Tex.

Area	Size	Rainfall	Runoff	Peak runoff per hr.	Land Use
	Acres	*Inches*	*Inches*	*Inches*	
W-1	176	3.26	1.173	1.17	Mixed cropping, no conservation
W-2	130	2.85	.935	.867	Mixed cropping, no conservation
W-6	42.3	3.00	Results not yet prepared		Mixed cropping, no conservation
W-10	19.7	2.63	.769	1.63	Mixed cropping, no conservation
Y	309	3.45	Results not yet prepared		Mixed cropping, conservation, terraces, improved rotations
Y-2	132	3.38	.865	1.04	Mixed cropping, conservation, terraces, improved rotations
Y-4	79.9	3.37	Results not yet prepared		Mixed cropping, conservation, terraces, improved rotations
Y-6	20.9	3.42	.713	.902	Conservation, 50 percent of cultivated land in oats
Y-7	40.0	3.35	1.401	1.80	Terraces, no improved rotation, 94% of area spring-planted crops
Y-8	20.8	3.42	1.045	1.34	Terraced, 4-year rotation, fescue grass and clover, 2 years; cotton, gain sorghum
Y-10	21.0	3.34	1.105	1.65	Terraced, 3-year rotation, oats, cotton, grain sorghum
SW-12	2.97	3.39	.129	.183	Native grass cut for hay
SW-17	2.99	2.230	1.230	.991	Heavily grazed improved pasture

New York

EFFECT OF BUFFALO CREEK FLOOD ON BANK STABILIZATION STUDIED

D. A. Parsons, East Aurora. --Another large flood in Buffalo Creek, New York, occurred on March 1. It provided an opportunity for observation of the effects of flood flows on newly installed streambank stabilization measures. Proper interpretation of the flood effects requires determination of peak flood flows at several places along the stream and an estimation of the frequency of occurrence of flows of the magnitudes found to have existed. Post-flood surveys and hydraulic computations are required in the absence of numerous gaging stations.

The flood originated in the central and lower portions of the watershed. The computed peak flows ranged from 5,500 cubic feet per second at Strykersville (drainage area, 45 square miles) with a frequency of 5 to 10 years, to 17,000 cfs at Wales Center (D. A., 110 sq. mi.) with a frequency of over 100 years, to 13,000 cfs at the downstream USGS Gardenville gaging station (D. A., 145 sq. mi.) with a frequency of 25 to 30 years. The probable errors in these frequency estimates are known to be large.

The suspended load concentration at the peak of the flow at Gardenville was about 5,000 ppm which is low, considering the size of the flood. The relatively low value is in keeping with the previously noticed trend for suspended load concentration in Buffalo Creek to vary directly with the distance of the flood origin from the gaging station.

The effects of the flood have not yet been adequately observed. Some unprotected banks were eroded away to a distance of 30 feet and more. New bank stabilization work was damaged in some places, but stood up beautifully in the main. The ever present tendency for down-valley migration of the meander pattern, with its profound influence on the proper positioning of bank revetment, was repeatedly noticed.

Mississippi

CREEK WASHING BANKS AWAY AT RATE OF .92 ACRE PER YEAR PER MILE

Russell Woodburn, State College. --Results of the bank erosion study on Big Sand Creek are shown in the table that follows. It appears that in a 15.77 mile reach of channel there has been a loss of bottom land at the rate of 0.92 acre per year per mile of channel or 422,000 cubic yards of sediment per year from the reach. On the basis of 18.7 inches of annual runoff, the bank erosion material would provide an annual average wash load of 0.19 pounds per cubic foot.

1955 Study of bank erosion on Big Sand Creek (reach from McCarley to Valley Hill) for 8-year period, 1941-49

Channel length	15.775 miles
Av. slope (upper end of reach)	.00131
Av. slope (lower end of reach)	.00105
Length of eroded bank	9.7 miles
Av. width of eroded bank strip	98 feet
Av. height of eroded bank strip	18 feet

$$\% \text{ of total bank in reach in eroding condition} = \frac{9.7}{31.550} = 30.7$$

Bottomland area lost by bank erosion, 8 yrs. = 116.5 acres

$$\text{Area lost per mile of channel, 8 yrs.} = \frac{116.5}{15.77} = 7.39 \text{ acres}$$

Land lost per channel mile per year = $\frac{7.39}{8}$ = 0.92 acres

Vol. of material lost per year = $\frac{116.5}{8}$ x 18 = 262 ac. ft. = 422,000 cu. yds.

If annual runoff is 18.7 inches, then 262 ac. ft. of material, mostly fines, may be carried at an average concentration of 0.192 lbs. per cu. ft.

Mississippi

CALCULATED AND OBSERVED SEDIMENT LOADS COMPARED

Russell Woodburn, State College.--Heavy runoff on several occasions presented opportunities to sample sediment-carrying flood flows for comparison with calculated loads in the Yazoo bluff area. Results are shown in the accompanying table.

In general, observed concentrations of sand ran from 0.06 pounds to 0.25 pounds per cubic foot. Computed loads were from 0.12 to 0.44 pounds per cubic foot--somewhat heavier than observed concentrations. Observed silt loads ran from 0.14 to 0.40 pounds per cubic foot.

Through improved application of transport theory and more precise sampling methods, an attempt will be made to bring computed and observed values closer together.

Calculated and observed sediment concentration for various flows in several sandbed streams (Bluff Line Area--Yazoo Basin) 1955

Dates and places	Approx. rate of discharge per second	Observed sediment concentration per cubic foot		Calculated Sediment concentration (for bed sand only) per cubic foot	
		Sand	Fines	Suspended load of bed sand	Total Load of bed sand
MARCH 21, 1955	*Cubic feet*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Big Sand Creek-					
Carrollton Bridge p.m..	15,800	High vel. prevented even rough sampling		0.568	0.587
Carrollton Bridge 11 a.m.....	11,000	.2522	.4196	0.44	0.46
Carrollton Bridge 11:30 a.m.....	10,000	.1722	.3943	0.41	0.43
Thompson Creek-					
McCarley Bridge p.m....	1,600	.1483	.2444	0.28	.3075
McCarley Bridge (later)	2,200	.1563	.3847	0.33	.350
Upper Big Sand-					
NcCarley Bridge p.m....	3,500	.0392	.1400	.025	.0255
FEBRUARY 21, 1955					
Big Sand Creek-					
Carrollton Bridge.....	5,000	.1667	.2123	0.23	0.26
FEBRUARY 6, 1955					
Big Sand Creek-					
Carrollton Bridge.....	2,300	.0631	.1398	0.12	0.15
JANUARY 18, 1955					
Big San Creek-					
Carrollton Bridge.....	2,500	.0764	.2505	0.12	0.15

NOTE: Compare Column 2 and Column 4

Kansas

SEDIMENT YIELD IN KANSAS GRAZING AREA IS 4 TONS PER ACRE PER YEAR

Louis M. Glymph, Jr., Lincoln.--A significant figure on the rate of sediment yield from a watershed in the "Bluestem-Hills" section of eastern Kansas has been obtained by a sedimentation survey of Kahola Reservoir, located in Morris and Chase counties.

The reservoir is a unit in the water supply system for the City of Emporia and began storing water in December 1936. It has a contributing drainage area of 15.3 square miles, about 85 percent of which is pasture or rangeland. A sedimentation survey in April 1954, made cooperatively by ARS, SCS, and the City of Emporia, showed that 553 acre-feet of sediment had accumulated in the basin in a period of 18.3 years. Adjusted for probable trap-efficiency during the storage period, the indicated total sediment yield amounts to 564 acre-feet during the life of the reservoir and the average annual yield is 2.01 acre-feet per square mile of drainage area. Assuming a dry weight for sediment of 60 pounds per cubic foot, the average annual sediment yield is 2,627 tons per square mile, or 4.10 tons per acre, of contributing drainage area. The reservoir had an original storage capacity of 6,500 acre-feet and a surface area of 409 acres.

Surface storage is a vital source of water in the Bluestem-Hills. Livestock in this important grazing section are largely dependent upon farm ponds for water supply.

This record of sediment yield is one indication of the quantity of sediment that may be expected from watersheds of the area which are predominantly in grass cover.

HYDRAULICS

Oklahoma

ACCURACY OF FLUME FOR WATER MEASUREMENT REDUCED BY SEDIMENTATION

W. O. Ree, Stillwater.--A new steel hydraulic testing flume was completed. Tests were started on a scale model of flume No. 3, Walnut Gulch, Tombstone, Arizona. Using clear water, a determination was made of the head-discharge relationship for this structure. This calibration showed that the measuring device operated as a critical depth meter. Back-water effects were also measured.

When the experiment was repreated using sediment-laden flows, deposition occurred in the flume at the head-measuring section. The reduction in cross-sectional area caused by this deposit resulted in a drop in the water surface elevation. This is best illustrated by an example.

With an unobstructed measuring station, the depth of flow for a discharge of 600 cubic feet per second was 5.70 feet. A sediment deposit at the measuring station caused a drop in head at this point to 5.12 feet for the same flow. This means that the head measurement made with sediment in place would indicate a discharge rate of only 460 c.f.s. instead of the 600 c.f.s. actually flowing.

Efforts to reduce deposition by changing the design of the approach section were only partly successful.

The scour experienced in the field structure on the upstream side was duplicated in the operation of the model. Experiments indicated that this scour could be controlled with rip rap.

Downstream scour patterns were obtained for various tailwater depths. Maximum scour in these tests reached a depth of 6 feet with low tailwater and 4 feet with tailwater deep enough to cause submergence of the flume throat.

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